Universidade de Évora - Escola de Ciências e Tecnologia

Mestrado Integrado em Medicina Veterinária

Relatório de Estágio

Combined midline and coronal rhytidectomy technique in the treatment of pseudoptosis in five dogs

Inês Marques Mesquita

Orientador(es) | Maria Teresa Oliveira
David Orlando Ferreira
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O relatório de estágio foi objeto de apreciação e discussão pública pelo seguinte júri nomeado pelo Diretor da Escola de Ciências e Tecnologia:

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Maria Teresa Oliveira (Universidade de Évora) (Orientador)

Évora 2022

To my beautiful grandparents,

Maria das Dores, José João, Deonilde e Manuel.

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Firstly, I want to thank my family with all my heart, especially my parents and brother, for their love, unwavering support, and always believing in me and my capabilities. I must also thank my beautiful cat Baltazar for being the best study partner.

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Abstract

Small Animal Practice and Surgery Combined midline and coronal rhytidectomy technique in the treatment of pseudoptosis due to redundant forehead skin in the dog

The present report emerges in the context of the curricular internship, part of the Integrated Master's Degree in Veterinary Medicine at the University of Évora, held at VetOeiras Veterinary Hospital, in Portugal, from 14th September 2020 until 12th February of 2021 and from 1st of April 2021 and 30th of July of the same year.

The report is divided into two sections. In the first part, a descriptive quantitative analysis of the cases presented to the author throughout the internship is given. In the second part, a five-case report series is presented regarding the management of pseudoptosis due to reluctant skin in the dog using a novel rhytidectomy surgical technique.

Keywords: report; ophthalmology; eyelids; pseudoptosis; rhytidectomy.

Resumo

Clínica e cirurgia de animais de companhia Técnica de ritidectomia mediana e coronal combinada no tratamento de pseudoptose devido a pele redundante no cão

O presente relatório surge no contexto do estágio curricular, parte do Mestrado Integrado em Medicina Veterinária da Universidade de Évora, realizado no Hospital Veterinário VetOeiras, em Portugal, a partir de 14 de setembro 2020 até 12 de fevereiro de 2021 e de 1 de abril de 2021 e 30 de julho do mesmo ano.

O relatório está dividido em duas seções. Na primeira parte, uma descrição da análise quantitativa dos casos apresentados ao autor ao longo do estágio é dado. Na segunda parte, é apresentada uma série de cinco casos sobre o maneio da pseudoptose por pele relutante no cão, usando a nova técnica cirúrgica de ritidectomia.

Palavras-chave: relatório; oftalmologia; pálpebras; pseudoptose; ritidectomia.

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ABBREVIATURE INDEX

ACEI: angiotensin converting enzyme inhibitor

ACL: anterior cruciate ligament

AP: acute pancreatitis

ARB: angiotensin receptor blocker

BAS: brachycephalic airway syndrome

CCB: calcium channel blocker

CHF: congestive heart failure

CKD: chronic kidney disease

CN III: oculomotor nerve

CN V: trigeminal nerve

CN VII: facial nerve

CP: chronic pancreatitis

CT: computerized tomography

DA: ductus arteriosus

DIC: disseminated intravascular coagulation

DM: diabetes *mellitus*

DVM: Doctor of Veterinary Medicine

EBVS: European Board of Veterinary Specialization

ECG: electrocardiography

ECS: English Cocker Spaniel

ECVO: European College of Veterinary Ophthalmologists

FCoV: feline coronavirus

FeLV: feline leukemia virus

FFP: folded flap palatoplasty

FHT: feline hyperthyroidism

fi: absolute frequency

FIP: feline infectious peritonitis

FIV: feline immunodeficiency virus

FLUTD: feline lower urinary tract disease

FNA: Fine-needle-aspiration

fr (%): relative frequency in percentage

HD: hip dysplasia

IOP: intraocular pressure

IRIS: International Renal Interest Society

LATE: laser-assisted turbinectomy

MCT: mast cell tumors

MRCVS: Member of the Royal College of Veterinary Surgeons

MRI: magnetic resonance imaging

MRSP: methicillin-resistant *Staphylococcus pseudintermedius*

NSAID: nonsteroidal anti-inflammatory drug

PDA: Persistent Ductus Arteriosus

PLI: pancreatic lipase immunoreactivity

PTH: parathormone

SCC: squamous cell carcinoma

SDMA: symmetric dimethylarginine

STT-I: Schirmer tear test-I

TPLO: tibial plateau leveling osteotomy

TTT: Tibial tuberosity transposition

UP/C: urine protein to creatinine ratio

UTI: urinary tract infection

1 INTRODUCTION

The purpose of the present report is to describe and document the activities developed during the two curricular internships, an intrinsic and conclusive stage of the Integrated Master's Degree in Veterinary Medicine at the University of Évora.

The first general internship took place at VetOeiras Veterinary Hospital, in Oeiras, Portugal, within a five-month period, from 14th September 2020 until 12th February of 2021, under the orientation of Professor Teresa Oliveira and external orientation of Dr. Cristina Seruca. The execution of this internship allowed the author to apply and solidify the theoretical knowledge acquired during the five-year academic course. It also enabled the acquisition of new learnings and contact with fields of veterinary medicine that the author was unaccustomed to. The second internship, also established in VetOeiras Veterinary Hospital, was only dedicated to veterinary ophthalmology, under the mentorship of Dr. Cristina Seruca. Between 1st of April 2021 and 30th of July of the same year, the author was able to assist, observe and learn from Dr. Cristina Seruca during consultations and surgical procedures.

The report is divided into two sections: the internship report and the monography. In the first part, the author starts with a brief characterization of the hospital and an overview of the internship schedule, followed by a descriptive quantitative analysis of the cases presented to the author during the internship extent. The data is divided by the different areas of small animal practice and by affected species. A concise review of the most frequent disorder in each field of medical practice is given. The final chapter of the first part is dedicated to the case-by-case analysis of the internship focused only on ophthalmology. In the second part, a series of case reports is presented in the management of pseudoptosis due to reluctant skin in the dog using a novel rhytidectomy surgical technique. A literature review on the subject is made.

2 INTERNSHIP REPORT

2.1 VETOEIRAS VETERINARY HOSPITAL

VetOeiras Veterinary Hospital, located in Oeiras, Portugal, was founded in September 1993 by Dr. Luís Chambel and Dr. Rui Almeida. The project was born from a necessity to provide veterinary services focused on animal welfare, in the capability to respond to various problems and illnesses presented by small animals and to strengthen the bond between the owner and their pet.

The project started as a small clinic and, through the years, expanded into what is now a multidisciplinary 24h hospital that offers services in the following areas: Preventive medicine, Internal medicine, Emergency, Dentistry, Feline Medicine, Surgery, Anesthesiology, Dermatology, Orthopedics, Ophthalmology, Insemination and Reproduction, Neurology, Exotic animals, Veterinary Physiotherapy, Imaging and Diagnosis (X-Ray, Ultrasound, and Computerized Tomography (CT)), Cardiology and Oncology. The VetOeiras team is a multifaced one composed of veterinarians, veterinary nurses, veterinary assistants, and front desk staff.

The hospital is all located on the ground floor of a collection of connected buildings. It consists of a hospitalization unit with three areas: a cats hospitalization (Figure 1A), a dog hospitalization, and isolation room for infectious or contagious patients; a pre-operative section (Figure 1B); two surgical blocks with a specific room for surgical equipment sterilization and a washing zone; an in-house laboratory; an X-Ray chamber; six consultation rooms: two general consultation rooms, one dedicated only to cats, one dedicated to exotic animals, one that serves as an ophthalmologic consultation room and one as an ultrasound room; a Computerized Tomography room; a pharmacy; a pet store; and a reception with two distinct zones, for cats and dogs.

The general internship was divided into six schedules: hospitalization, surgery, anesthesia, consultations, night shifts, and weekends/holidays. The interns would rotate between schedules in a randomized fashion, except the surgery service, where interns would rotate in a specific order every two weeks.

Figure 1 - VetOeiras Veterinary Hospital facilities. (A) Cat hospitalization. (B) The preoperative area in the foreground and the laboratory in the background (author's photographs).

The hospitalization had two shifts, one from 9 am to 5 pm and another from 5 pm to 12 am (midnight). There was only one shift in the surgery and anesthetic services, from 9 am to 5 pm. The consultation schedule was from 11 am to 8 pm, and the night shift was from 8 pm to 10 am of the next day. Saturday and Sunday were covered by only one intern each from 9 am to 12 am (midnight). The author also participated in a weekly paper review discussion between interns, promoted by the hospital, called “Nerd Club”.

In the ophthalmology internship, the schedule was, generally, from 9 am to 3 pm. All weekdays were reserved for consultations, except Wednesdays that was designated for surgical procedures only.

2.2 CASE-BY-CASE ANALYSIS: GENERAL INTERNSHIP

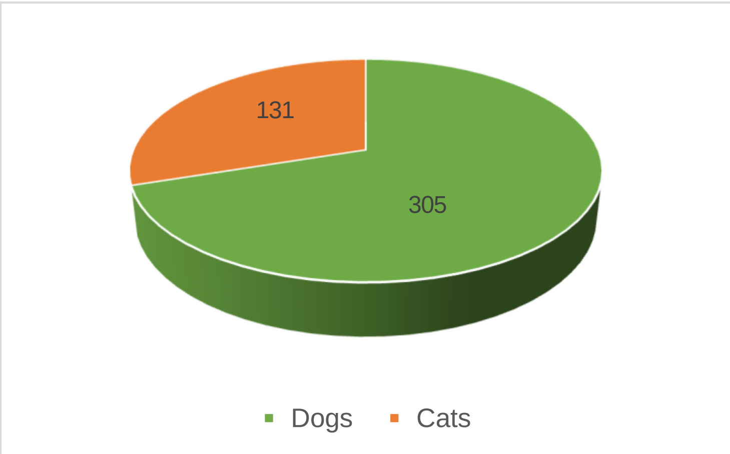
During the internship, the author observed, assisted, and studied various procedures and cases presented at VetOeiras Veterinary Hospital. In this chapter, a case-by-case analysis is displayed in order to conveniently show and describe the activities the author took part in during the internship.

The data is organized into three groups: medical practice, surgical practice, and imaging. The first two groups are subdivided into smaller sections of medical and/or surgical specialties, and the last group by the used technique. The analysis is presented through graphs and tables, using the absolute frequency (fi) and relative frequency (fr (%)) values by species, disease/procedure, and the total number of cases. At the end of each subgroup, a concise review of the most frequent disorder observed in that specific field is given.

This analysis is not an authentic demonstration of all the cases presented at VetOeiras Veterinary Hospital during the five-month internship. The author was part of specific departments and did not always accompany all areas. It is also possible that a specific patient is accounted for in two or more different groups or subgroups due to concomitant diseases.

2.2.1 Distribution by species

During the internship, the author followed a total of 436 cases, of which 305 (70%) belong to dogs and 131 (30%) to cats. The absolute frequency (fi) of the species seen during the internship is shown schematically in Graph 1.



Graph 1 - Distribution of the cases followed by species, expressed in fi.

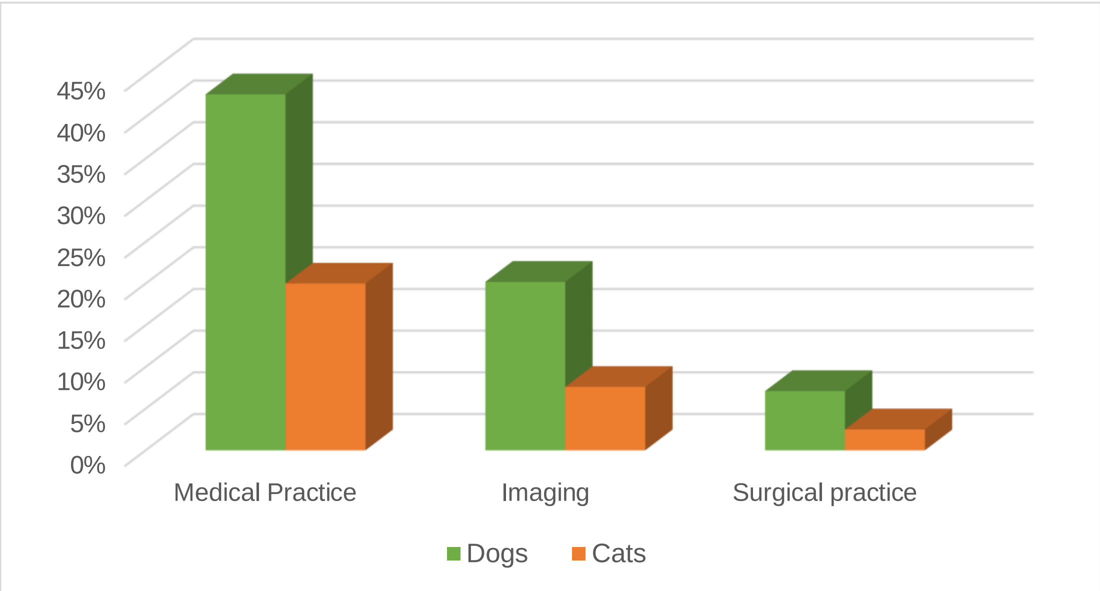
2.2.2 Distribution by clinical areas

The total cases are divided into three groups: medical practice, surgical practice, and imaging. Each of these divisions is individually discussed later.

Table 1 and Graph 2 display the fi and fr (%) of the cases divided by area of practice and by species.

Table 1 - Distribution of the cases followed by species and area of practice, expressed in fi and fr (%).

	Dogs		Cats		Total	
	fi	fr (%)	fi	fr (%)	fi	fr (%)
Medical Practice	186	42.7%	87	20%	273	62.6%
Imaging	88	20.2%	33	7.6%	121	27.8%
Surgical Practice	31	7.1%	11	2.5%	42	9.6%
Total	305	70%	131	30%	436	100%



Graph 2 - Distribution of the cases followed by species and area of practice, expressed in fr (%).

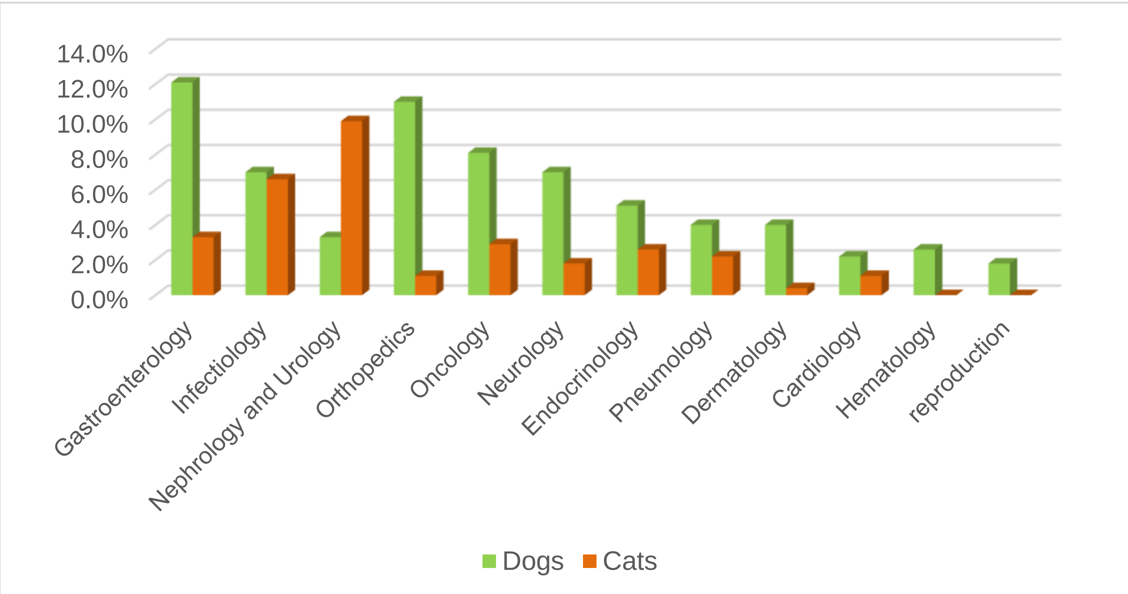
The medical practice registered a higher number of cases, with an fr (%) 62.6% (n=273) while the surgical practice and imaging compose 9.6% (n=42) and 27.8% (n=121) of the cases, respectively.

2.2.3 **Medical Practice**

The cases accompanied in the medical practice is subdivided according to the fields of specialization, as seen resumed in Table 2 and Graph 3.

Table 2 - Distribution of the cases followed in the medical practice, divided by species and specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Medical Practice	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Gastroenterology	33	12.1%	9	3.3%	42	15.4%
Infectious diseases	19	7%	18	6.6%	37	13.6%
Nephrology and Urology	9	3.3%	27	9.9%	36	13.2%
Orthopedics	30	11%	3	1.1%	33	12.1%
Oncology	22	8.1%	8	2.9%	30	11%
Neurology	19	7%	5	1.8%	24	8.8%
Endocrinology	14	5.1%	7	2.6%	21	7.7%
Pneumology	11	4%	6	2.2%	17	6.2%
Dermatology	11	4%	1	0.4%	12	4.4%
Cardiology	6	2.2%	3	1.1%	9	3.3%
Hematology	7	2.6%	0	0%	7	2.6%
Reproduction	5	1.8%	0	0%	5	1.8%
Total	186	68.1%	87	31.9%	273	100%



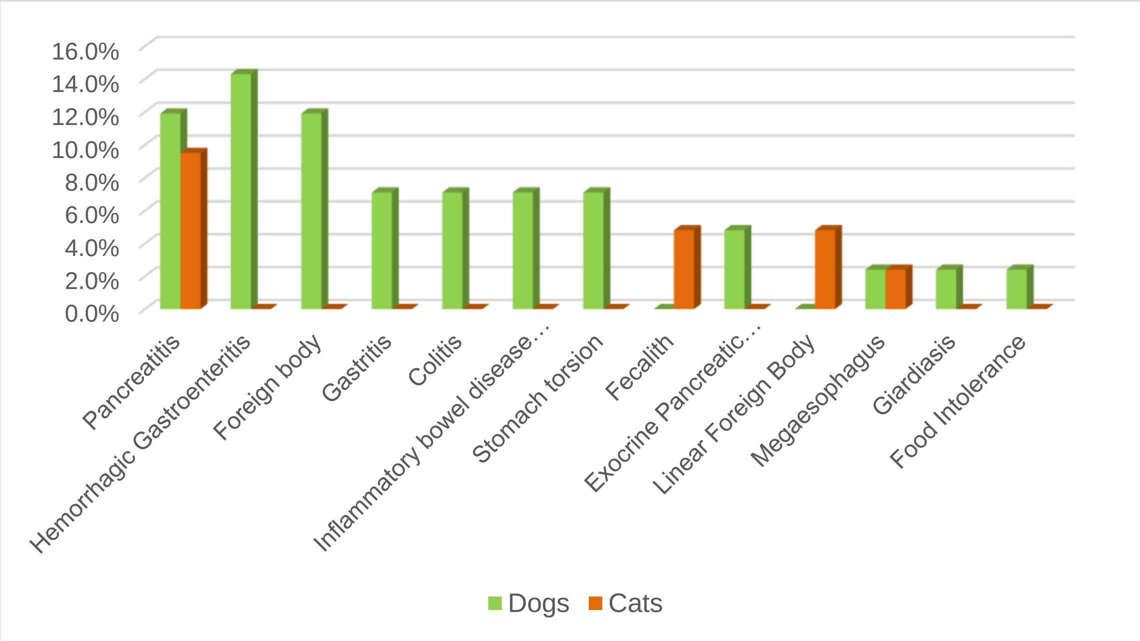
Graph 3 - Distribution of the cases followed in the medical practice, divided by species and specialty, expressed in fr (%).

2.2.3.1 Gastroenterology

All the cases followed in the gastroenterology area are listed in Table 3 and are schematically displayed in Graph 4, organized by disease and by species. The most prevalent condition observed was pancreatitis, representing 21.4% of the gastroenterology cases assisted, followed by haemorrhagic gastroenteritis (14.3%), foreign body (11.9%) and gastritis (7.1%).

Table 3 - Distribution of the cases followed in the gastroenterology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Gastroenterology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Pancreatitis	5	11.9%	4	9.5%	9	21.4%
Hemorrhagic gastroenteritis	6	14.3%	0	0%	6	14.3%
Foreign body	5	11.9%	0	0%	5	11.9%
Gastritis	3	7.1%	0	0%	3	7.1%
Colitis	3	7.1%	0	0%	3	7.1%
Inflammatory bowel disease (IBD)	3	7.1%	0	0%	3	7.1%
Stomach Torsion	3	7.1%	0	0%	3	7.1%
Fecalith	0	0%	2	4.8%	2	4.8%
Exocrine Pancreatic Insufficiency (EPI)	2	4.8%	0	0%	2	4.8%
Linear Foreign Body	0	0%	2	4.8%	2	4.8%
Megaesophagus	1	2.4%	1	2.4%	2	4.8%
Giardiasis	1	2.4%	0	0%	1	2.4%
Food Intolerance	1	2.4%	0	0%	1	2.4%
Total	33	78.6%	9	21.4%	42	100%



Graph 4 - Distribution of the cases followed in the gastroenterology specialty, expressed in fr (%).

Pancreatitis is a common affection of cats and dogs, and it can range from acute to chronic and from mild to severe (Watson, 2015).

Acute pancreatitis (AP) is characterized by neutrophil infiltration, edema, and necrosis to various extents, without the presence of fibrosis or exocrine atrophy (Mansfield, 2012; Watson, 2015). These changes can be structurally and functionally reversible, even though AP is a potentially fatal condition.

Chronic pancreatitis (CP) generally is a progressive disease that displays irreversible histopathological changes, such as fibrosis and acinar loss, resulting in loss of function. Although histological proof is the *gold standard* in the differentiation between AP and CP, a clear consensus is still warranted for a histological description of pancreatic disease in the veterinary literature (Watson, 2015).

Whether AP or CP, the etiology or etiologies of pancreatic disease is still mostly unknown, despite many risk factors are identified for AP in dogs (Mansfield, 2012; Watson, 2015). These include breed, obesity, gender (males and neutered females), history of recent surgery, hyperlipidemia, and specific drugs. Concomitant endocrine conditions, like Diabetes Mellitus (DM), hyperadrenocorticism, and hypothyroidism, are also risk factors in fatal AP (Watson, 2015).

Histological diagnosis is not usually performed, even though discrimination between types of pancreatitis can have therapeutic and prognostic implications (Watson, 2015; Xenoulis, 2015).

A presumptive diagnosis is usually made based on functional changes and clinical, clinicopathological, and imaging findings (Watson, 2015).

Diagnosing pancreatitis can be challenging: clinical presentation and clinicopathological findings are non-specific for pancreatic disease (Xenoulis, 2015). The clinical presentation of AP in dogs may involve acute onset anorexia, depression, dehydration, fever or hypothermia, emesis, diarrhea, icterus, abdominal pain, bleeding diathesis, and ascites. Critical cases of AP can present with severe systemic complications, such a cardiovascular shock, acute renal failure, acute lung injury, disseminated intravascular coagulation (DIC), and multi- organ failure (Mansfield, 2012; Xenoulis, 2015).

In CP, clinical signs are milder than AP, recurrent, and further clinical signs frequently result from concomitant pathologies. Aside from the lower frequency in gastrointestinal signs, the clinical picture is similar in cats with pancreatitis. Cats' most frequent signs of pancreatitis are anorexia, lethargy, dehydration, pallor, and icterus (Xenoulis, 2015).

A clinicopathological routine examination is not diagnostic because of lack of specificity for pancreatic illness. These should always be performed in a cat or dog suspect of pancreatitis, even to exclude other disorders and to get a picture of the patient's overall health condition. The pancreatic lipase immunoreactivity (PLI) assays are currently considered the most sensitive and specific serum tests for diagnosing pancreatitis in both species. Abdominal ultrasound is considered the imaging method of choice for the diagnosis of pancreatitis in dogs and cats (Xenoulis, 2015).

Treatment of pancreatic disease should include treatment directed at the cause of inflammation, if found, and supportive care. Supportive care consists of intravenous fluid therapy, analgesia, with opioids as a primary choice, anti-emetics, gastric acid suppression, and nutritional management. Prudent corticosteroid therapy should be considered if AP is unresponsive to current therapy (Mansfield, 2012).

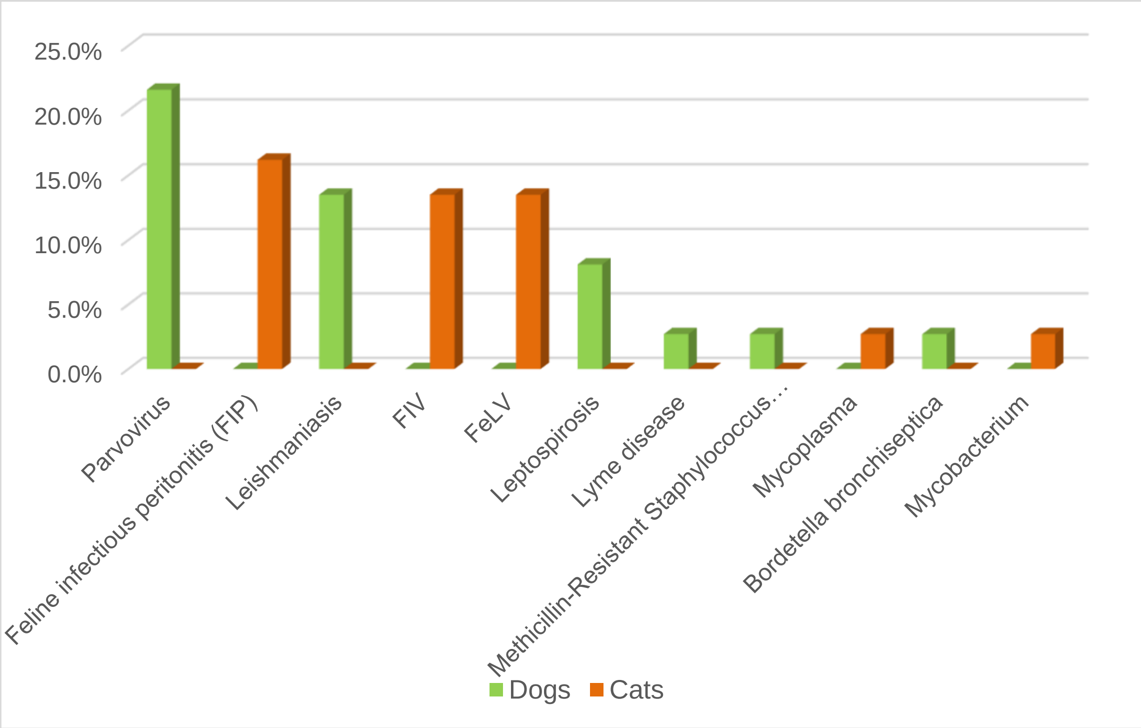
2.2.3.2 Infectious Diseases

All the cases followed in the infectious diseases area are listed in Table 4 and schematically displayed in Graph 5, organized by disease and by species. The most prevalent condition observed was Parvovirus, representing 21.6% of the infectious cases assisted, followed by Feline infectious peritonitis (FIP) (16.2%), Leishmaniosis (13.5%) and Feline immunodeficiency virus (FIV) (13.5%).

Although FIP was not the condition the author had more contact with during the internship, it prompted curiosity and willingness to know more about the virus and ways to detect and treat the disease; for that reason, it was chosen to be reviewed in this section.

Table 4 - Distribution of the cases followed in the infectious diseases' specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Infectious	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Parvovirus	8	21.6 %	0	0%	8	21.6 %
Feline infectious peritonitis (FIP)	0	0%	6	16.2 %	6	16.2 %
Leishmaniosis	5	13.5 %	0	0%	5	13.5 %
Feline immunodeficiency virus (FIV)	0	0%	5	13.5 %	5	13.5 %
Feline leukemia virus (FeLV)	0	0%	5	13.5 %	5	13.5 %
Leptospirosis	3	8.1%	0	0%	3	8.1%
Lyme disease	1	2.7%	0	0%	1	2.7%
Methicillin-resistant *Staphylococcus Pseudintermedius* (MRSP)	1	2.7%	0	0%	1	2.7%
Mycoplasma spp.	0	0%	1	2.7%	1	2.7%
Bordetella bronchiseptica	1	2.7%	0	0%	1	2.7%
Mycobacterium spp.	0	0%	1	2.7%	1	2.7%
Total	19	51.4 %	18	48.6 %	37	100 %



Graph 5 - Distribution of the cases followed in the infectious diseases' specialty, expressed in fr (%).

The feline coronavirus (FCoV) is responsible for pervasive enteric infection of domestic felines and, on rare occasions, leads to the development of an immune-mediated vasculitis, called feline infectious peritonitis (FIP) (Addie, 2012).

Risk factors associated with the development of FIP are age and breed, although FIP can develop at any age and in any cat breed. Kittens and cats under two years old are more likely to develop FIP and succumb to it, with a second peak of age-related risk appearing at ten years of age. Pedigree cats are more likely to develop FIP when compared with non-purebred cats (Addie, 2012).

FIP has two types of clinical presentation: effusive or wet FIP and non-effusive or dry FIP, and although discrimination is often made between the two forms, they are not mutually exclusive, and, with the progression of the disease, may change from one to the other (Drechsler *et al.*, 2011).

Clinical presentation of a cat with effusive FIP is characterized by ascites and thoracic and abdominal effusion due to generalized pyogranulomatous vasculitis, with secondary plasma and protein exudation in body cavities. Mild pyrexia, weight loss, dyspnea, and tachypnea, muffled heart sounds, mucous pallor, icterus, scrotal enlargement, and abdominal masses are clinical sing also associated with wet FIP (Addie, 2012; Drechsler *et al.*, 2011) .

Non-effusive FIP is considered a more chronic presentation since clinical manifestation occurs weeks to many months after initial infection. Non-specific sing like mild pyrexia, weight loss, dullness, hyporexia, icterus, and palpable organomegaly are common in dry FIP (Drechsler *et al.*, 2011). Many animals also present ocular, neurologic, dermatologic, and intestinal abnormalities (Addie, 2012). The most common ocular abnormality observed in FIP is uveitis, which often progresses to panuveitis or panophthalmitis, and “mutton fat” keratic precipitates. Other ocular lesions such as pyogranulomatous chorioretinitis and retinal vasculitis may be present with clinically evident perivascular cuffing, exudative retinal detachments, and optic neuritis (Drechsler et al., 2011; Glaze et al., 2021). The most common neurological signs include abnormal mental status, ataxia, central vestibular signs, hyperesthesia, nystagmus, and seizures (Drechsler *et al.*, 2011). Neurological signs represent a poorer prognosis (Addie, 2012).

Diagnosing FIP can be challenging, and definitive diagnosis is often only made post-mortem with histopathological findings consistent with phlebitis or perivascular pyogranuloma. It is often easier to rule out non-FIP conditions in clinical practice than to make a definitive FIP diagnosis. Clinical diagnosis is made based on signalment, clinical history, clinical signs, CBC, serum biochemistry, including serum protein electrophoresis and effusion fluid analysis (Addie, 2012). FCoV-specific testing, such as immunofluorescence of macrophages in effusion and PCR may be of use (Kennedy, 2020).

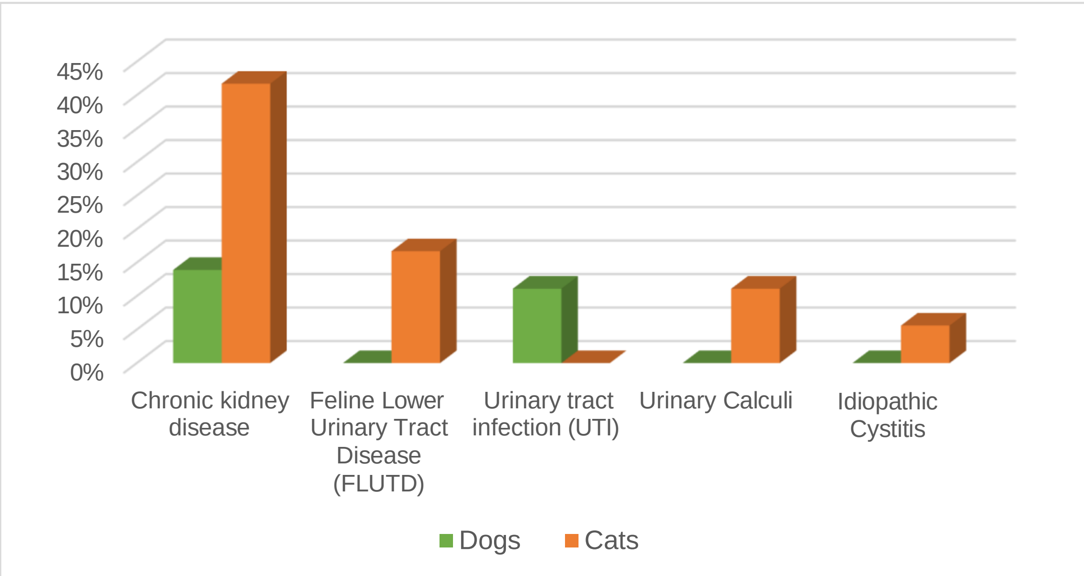
New antiviral therapies targeting FCoV replication such as the GC376 and GS-441524 have been showed to be successful options on the treatment of FIP (Kennedy, 2020; Pedersen et al., 2019).

2.2.3.3 Nephrology and Urology

All the cases followed in the nephrology area are listed in Table 5 and schematically displayed in Graph 6, organized by condition and by species. The most prevalent condition observed was chronic kidney disease (CKD), representing 55.6% of the nephrology cases assisted, followed by Feline Lower Urinary Tract Disease (FLUTD) (16.7%), Urinary tract infection (UTI) (11.1%) and Urinary calculi (11.1%).

Table 5 - Distribution of the cases followed in the nephrology and urology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Urinary	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
CKD	5	13.9%	15	41.7%	20	55.6%
FLUTD	0	0%	6	16.7%	6	16.7%
UTI	4	11.1%	0	0%	4	11.1%
Urinary calculi	0	0%	4	11.1%	4	11.1%
Idiopathic Cystitis	0	0%	2	5.6%	2	5.6%
Total	9	25%	27	75%	36	100%



Graph 6 - Distribution of the cases followed in the nephrology and urology specialty, expressed in fr (%).

Chronic kidney disease (CKD) is an irreversible and typically slowly progressive disease defined by loss of function and structure of one or both kidneys that has been present for three or more months. Frequently considered a disease of older animals, CKD incidence increases with age in cats and dogs. While many causes have been proposed as possible triggers for CKD in dogs and cats, the etiology of kidney disease often cannot be determined (Polzin, 2017).

The diagnostic approach to CKD must recognize functional and structural kidney abnormalities. Laboratory findings include azotemia, hyperphosphatemia, hypoalbuminemia, hypo or hyperkalemia, metabolic acidosis, hypo or hypercalcemia, and non-regenerative anemia that indicates loss of renal function. Impaired urine concentration, proteinuria, cylindruria, hematuria, pyuria, inappropriate urine pH, inappropriate urine glucose, cystinuria, and bacteriuria are urine markers that should incite investigation to determine whether they result from kidney disease. Kidney abnormalities noted by imaging studies should also be investigated (Polzin, 2017).

In order to promote appropriate treatment and monitoring of the patient, CKD staging is indicated following diagnosis. Staging is based on blood creatinine and SDMA concentrations (Table 6), both assessed on at least two occasions in a hydrated and stable patient; substage is then performed based on proteinuria and blood pressure. Proteinuria sub-staging is accomplished through urine protein to creatinine ratio (UP/C) measurement, after evidence of urinary tract inflammation, hemorrhage, and dysproteinemias have been ruled out. Blood pressure classification should rely on multiple systolic blood pressure measurements (IRIS, 2019).

Table 6 – IRIS staging in dogs and cats (adapted from IRIS, 2019).

	Blood Creatine (mg/dL)		SDMA (µg/dL)	
	Dogs	**Cats**	**Dogs**	**Cats**
Stage 1	<1.4	<1.6	<18	<18
Stage 2	1.4 – 2.8	1.6 – 2.8	18 - 35	18 - 25
Stage 3	2.9 – 5.0	2.9 – 5.0	36 - 54	26 - 38
Stage 4	>5.0	>5.0	>54	>38

All CKD treatments need to be custom-made to the individual patient; however, treatment recommendations are generally made based on the

International Renal Interest Society (IRIS) staging (IRIS, 2019). The measures taken in each stage are cumulative, meaning that the recommendations made on stage one should be implemented on stage two, and the ones made on stage two should be applied on stage three and so on.

When a patient is on stage one, all potentially nephrotoxic drugs should be discontinued, any pre-renal or post-renal abnormalities should be identified and treated, any treatable conditions should be ruled out, and proteinuria and blood pressure should be assessed for sub staging. If the patient is dehydrated, fluid therapy should start with an isotonic polyionic replacement fluid solution (e.g., lactated Ringer's) IV or SQ. If arterial hypertension is noted, treatment should be instituted. In the dog, this includes dietary sodium reduction, angiotensin-converting enzyme inhibitor (ACEI) therapy, a combination of ACEI and a calcium channel blocker (CCB), and a combination of ACEI, CCB, and angiotensin receptor blocker (ARB) or hydralazine. In the cat, hypertension therapy includes dietary sodium reduction, administration of CCB or ARB, and a combination of the two, if needed. Dogs with UP/C > 0,5 and cats with UP/C > 0,4 should be assessed for illnesses leading to proteinuria and treated with anti-proteinuric measures. These include, in dogs, as the first measure, the administration of ACEI in combination with a clinical renal diet; the administration of ARB if proteinuria is not controlled and the administration of low-dose acetylsalicylic acid or clopidogrel if serum albumin is <20 g/L. In cats it's recommended the administration of a renin-angiotensin-aldosterone system inhibitor (ACEI or ARB) and feed a clinical renal diet (IRIS, 2019).

In stage two, to keep the phosphate levels below 1.5 mmol/L, which is suggested to be beneficial to patients with CKD, a dietary phosphate restriction should be attempted and, if plasma phosphate concentration remains above 1.5 mmol/L (4.6 mg/dL) after this measure, enteric phosphate binders should be given. If hypokalemic, the patient should be supplemented with potassium gluconate or potassium citrate to effect (IRIS, 2019).

On stage three, evidence suggests that careful use of calcitriol prolongs survival in dogs when phosphate is controlled, and ionized calcium and parathormone (PTH) are monitored. Contrariwise, cats don't seem to benefit from this therapy. If metabolic acidosis exists, the patient should be supplemented with oral sodium bicarbonate. Emesis, hyporexia, nausea, and weight loss should be treated with an anti-emetic and appetite stimulant. Drugs that rely on renal function for their clearance should be used with caution in patients in stage three CKD (IRIS, 2019).

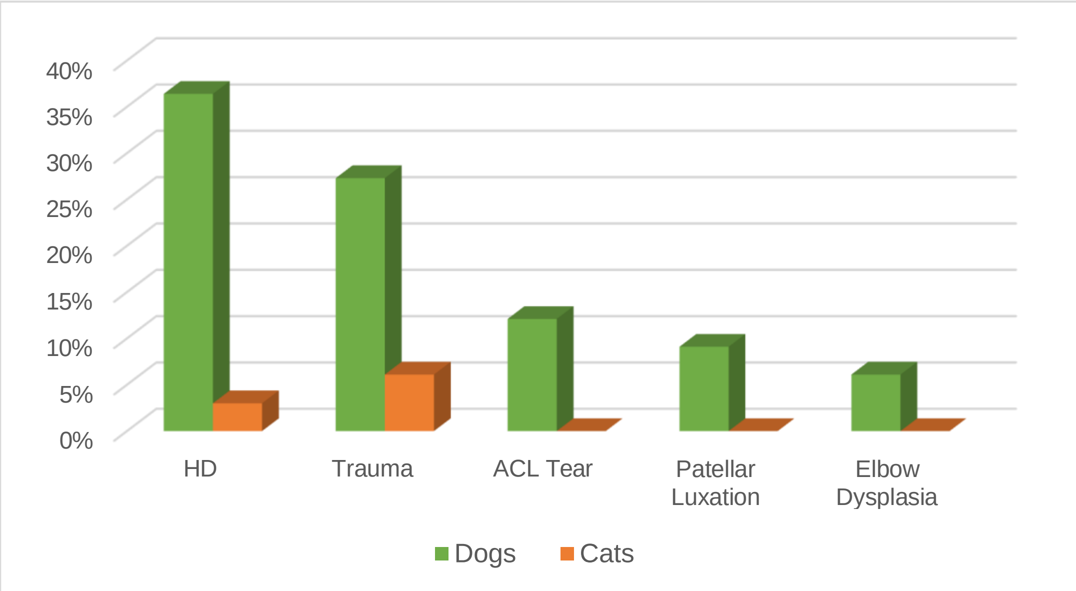
In patients in stage four CKD, efforts should be made to prevent protein and calorie malnutrition and prevent dehydration. Dialysis and renal transplantation should be considered (IRIS, 2019).

2.2.3.4 Orthopedics

All the cases followed in the Orthopedics field are listed in Table 7 and schematically displayed in Graph 7, organized by condition and by species. The most prevalent condition observed was hip dysplasia (HD), representing 39.4% of the orthopedics cases assisted, followed by trauma (33.3%), anterior cruciate ligament (ACL) tear (12.1%) and patellar luxation (9.1%).

Table 7 - Distribution of the cases followed in the orthopedics specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Orthopedics	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
HD	12	36.4%	1	3%	13	39.4%
Trauma	9	27.3%	2	6.1%	11	33.3%
ACL Tear	4	12.1%	0	0%	4	12.1%
Patellar Luxation	3	9.1%	0	0%	3	9.1%
Elbow Dysplasia	2	6.1%	0	0%	2	6.1%
Total	30	90.9%	3	9.1%	33	100%



Graph 7 - Distribution of the cases followed in the orthopedics specialty, expressed in fr (%).

HD is the most common orthopedic condition diagnosed in the dog. Although most prevalent in large, fast-growing breeds such as Labrador retrievers, Newfoundlands, Rottweilers, St. Bernards, and mastiffs, small and medium-sized breeds like the Bulldogs, pugs, and some terrier breeds are also predisposed (King, 2017; Smith *et al.*, 2018).

HD is a complex disease of inheritance, where a polygenetic basis combined with environmental factors can influence the expression of the condition (King, 2017; Smith *et al.*, 2018). The pathogenesis of the condition remains unclear (Smith *et al.*, 2018). The condition was first described in 1996 by Henrigson, Norberg and Olssons as "a varying degree of laxity of the hip joint permitting subluxation during early life, giving rise to varying degrees of shallow acetabulum and flattening of the femoral head, finally, inevitably leading to osteoarthritis"; although hip laxity is the primary risk factor for the development of osteoarthritis (Smith *et al.*, 2018), it does not seem to be sufficient in isolation for the development of HD (King, 2017).

The diagnose of HD in the dog is made based on imaging abnormalities together with physical exam findings. Imaging modalities such as radiography, CT, ultrasound, and magnetic resonance imaging (MRI) can be used to evaluate dogs suspected of HD. The hip-extended radiograph is the most commonly used radiographic projection for evaluating the hips. This ventrodorsal projection enables the evaluation of the joint for signs of osteoarthritis and allows the calculation of the Norberg angle and the femoral overlap, which are two ways to objectively quantify the degree of femoral subluxation. Additional diagnostic radiographic methods such as distraction-stress radiography techniques have improved the sensitivity of laxity detection (Butler and Gambino, 2017).

Medical therapy for the management of hip osteoarthritis is considered palliative, with reduction of joint pain and improved limb function being the goals of treatment. Medical therapy includes nutritional changes, exercise modification, physical therapy, and pharmacologic management (Smith *et al.*, 2018).

Surgical management can be divided into prophylactic, salvage, and palliative treatment. Juvenile pubic symphysiodesis and pelvic osteotomy are prophylactic procedures where the objective is to prevent the development of secondary osteoarthritis. Salvage procedures aim to replace or eliminate the source of pain and include total hip arthroplasty and femoral head and neck excision. Palliative procedures are uncommon nowadays (Vezzoni and Peck, 2018).

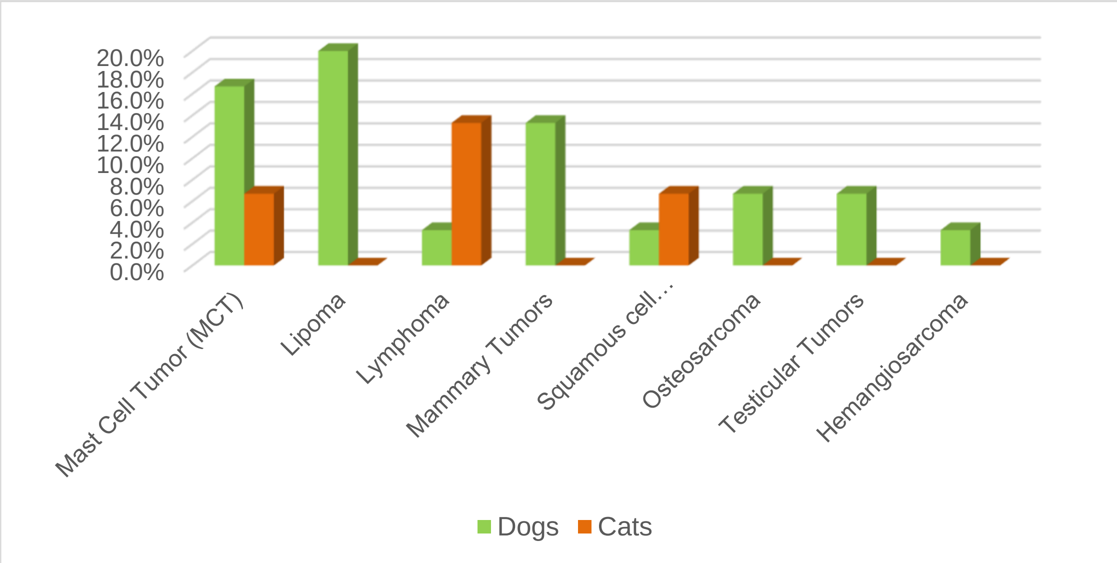
2.2.3.5 Oncology

All the cases followed in the Oncology field are listed in Table 8 and schematically displayed in Graph 8, organized by type of tumor and by species. The most prevalent neoplasms were mast cell tumors (MCT), representing 23.3% of the oncological cases assisted, followed by lipomas (20%), lymphomas (16.7%) and mammary tumors (13.3%).

Table 8 - Distribution of the cases followed in the oncology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Oncology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
MCT	5	16.7%	2	6.7%	7	23.3%
Lipoma	6	20%	0	0%	6	20%
Lymphoma	1	3.3%	4	13.3%	5	16.7%
Mammary tumors	4	13.3%	0	0%	4	13.3%
Squamous cell carcinoma (SCC)	1	3.3%	2	6.7%	3	10%

Osteosarcoma	2	6.7%	0	0%	2	6.7%
Testicular tumors	2	6.7%	0	0%	2	6.7%
Hemangiosarcoma	1	3.3%	0	0%	1	3.3%
Total	22	73.3%	8	26.7%	30	100%



Graph 8 - Distribution of the cases followed in the oncology specialty, expressed in fr (%).

MCTs account for 16-21% of all skin tumors in the dog and approximately 20% in the cat. MCT in dogs frequently occurs in older patients, and breeds such as Boxers, Retrievers, Pugs, Boston Terrier, and Pit-bull terriers are predisposed. The etiology of MTC is still undetermined (Blackwood *et al.*, 2012).

MCT can arise anywhere in the body, including mucous membranes and internal organs, but are usually located in the cutaneous and subcutaneous tissue. MCT can appear as single or multiple lesions, the former being the most common presentation. Cutaneous MCT can be well or poorly differentiated. Well-differentiated tumors are generally slow-growing, hairless, and solitary, while poor-differentiated tumors have a rapid growing, ulcerated and pruritic appearance, sometimes accompanied by “satellite lesions” and local lymphadenopathy or organomegaly (Blackwood *et al.*, 2012).

Clinical presentation of MCT corresponds, to some degree, with the histological grade of the tumor. Clinical signs such as fast growth, perilesional inflammation and infiltration, ulceration, presence of satellites lesions, and the existence of paraneoplastic syndrome suggest aggressive behavior (Blackwood *et al.*, 2012). Conversely, localized tumors that display an unaltered appearance over months to years tend to be classified with benign behavior. Patients can display paraneoplastic syndrome, a consequence of the release of histamine, heparin, and proteases from mast cell granules, resulting in local edema, ulceration, swelling, delayed cicatrization, and coagulation abnormalities. Furthermore, clinical signs secondary to ulceration, like vomiting, gastrointestinal hemorrhage, anorexia, and abdominal pain, are common systemic effects secondary to histamine released by neoplastic mast cells (Blackwood *et al.*, 2012).

Fine-needle-aspiration (FNA) cytology provides MCT diagnosis in 92% to 96% of the cases; it does not, however, provide tumor grading. For an accurate histological grade, histopathology is necessary. The histological tumor grade is considered a critical prognostic factor for MCT. Nevertheless, lymph node metastasis, anatomic location, clinical behavior, response to treatment, c-Kit expression, and cell proliferation markers can provide a predictive prognosis (Blackwood *et al.*, 2012).

Staging is the next step once a MCT diagnosis has been made. Because MCTs tend to metastasize to draining lymph node(s), liver, spleen, and bone marrow, a complete staging study should include FNAs of draining lymph nodes and abdominal ultrasound as a minimum. For patients with confirmed metastasis, complete staging, including abdominal ultrasound, together with spleen and liver FNA, and eventual bone marrow aspiration and lung radiographs are mandatory (Blackwood *et al.*, 2012).

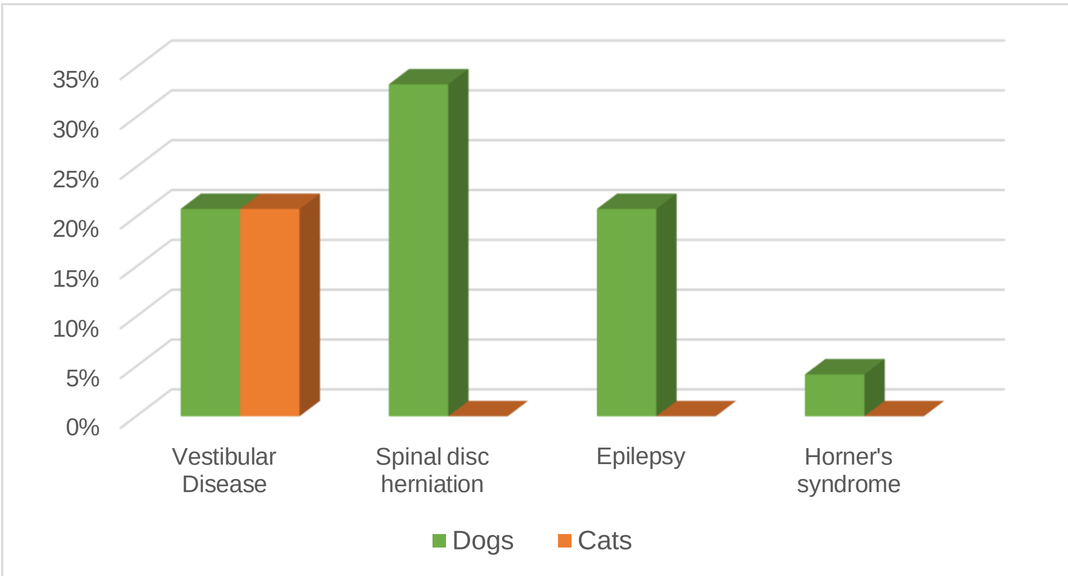
Surgery is considered the treatment of choice in localized, nonmetastatic MCTs in dogs. Systemic treatment with chemotherapy is most appropriate for tumors with a high risk of metastases or when complete tumor excision is not possible. According to the “European consensus document on MCTs in dogs and cats”, first-line therapy consists of vinblastine and prednisolone, and second-line therapy of lomustine (Blackwood *et al.*, 2012).

2.2.3.6 Neurology

All the cases followed in the Neurology field are listed in Table 9 and schematically displayed in Graph 9, organized by condition and by species. The most prevalent condition observed was vestibular disease, representing 41.7% of the neurologic cases assisted, followed by spinal disc herniation (33.3%), idiopathic epilepsy (20.8%) and Horner's syndrome (4.2%).

Table 9 - Distribution of the cases followed in the neurology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Urinary	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Vestibular disease	5	20.8%	5	20.8%	10	41.7%
Spinal disc herniation	8	33.3%	0	0%	8	33.3%
Epilepsy	5	20.8%	0	0%	5	20.8%
Horner's syndrome	1	4.2%	0	0%	1	4.2%
Total	19	79.2%	5	20.8%	24	100%



Graph 9 - Distribution of the cases followed in the neurology specialty, expressed in fr (%).

The vestibular system is essential to the maintenance of balance and body and ocular positioning. Therefore, when vestibular dysfunction is present, abnormalities of the gait, head and body posture, and abnormal ocular movement are observed (Rossmeisl, 2010).

Clinical signs characteristic of vestibular dysfunction includes head tilt, pathologic nystagmus, vestibular strabismus, and vestibular ataxia(Rossmeisl, 2010).

Vestibular dysfunction can originate from the peripheral or central vestibular system. So, after identifying any of these features, the priority should be to assess if the origin of the problem is either in the peripheral or central vestibular system (Rossmeisl, 2010; Sammut, 2017).

Peripheral vestibular disorder signs include asymmetric ataxia and loss of balance, in the absence of paresis or proprioceptive deficits, and spontaneous or positional horizontal or rotary nystagmus, with the fast phase away from the side of the lesion. The nystagmus in peripheral vestibular disease will not change directions as the head position is changed. Peripheral vestibular lesions can also affect the facial nerve and the postganglionic sympathetic innervation to the head (Rossmeisl, 2010).

Besides detailed history and neurologic examination, diagnostic methods helpful in assessing the peripheral vestibular apparatus include otoscopic examination, bulla radiographs and ultrasound, microbiology, myringotomy, FNA, serology, and biopsy procedures (Rossmeisl, 2010).

Differential diagnoses of peripheral vestibular disorder should include otitis interna and media, nasopharyngeal polyps, idiopathic vestibular disease, ototoxicosis, and iatrogenic trauma. Rarer conditions such as congenital vestibular disease and ear canal or middle ear neoplasia can also lead to peripheral vestibular disease (Sammut, 2017).

A clinical presentation of depression, spastic hemiparesis, cranial nerves V-XII deficits, or general proprioceptive deficits is compatible with a central vestibular disorder. Identification of hemi- or tetraparesis in an animal with vestibular signs is the most reliable indicator of the presence of a central vestibular lesion. Spontaneous vertical nystagmus or pathologic nystagmus that changes direction also indicates the presence of central vestibular disease (Rossmeisl, 2010).

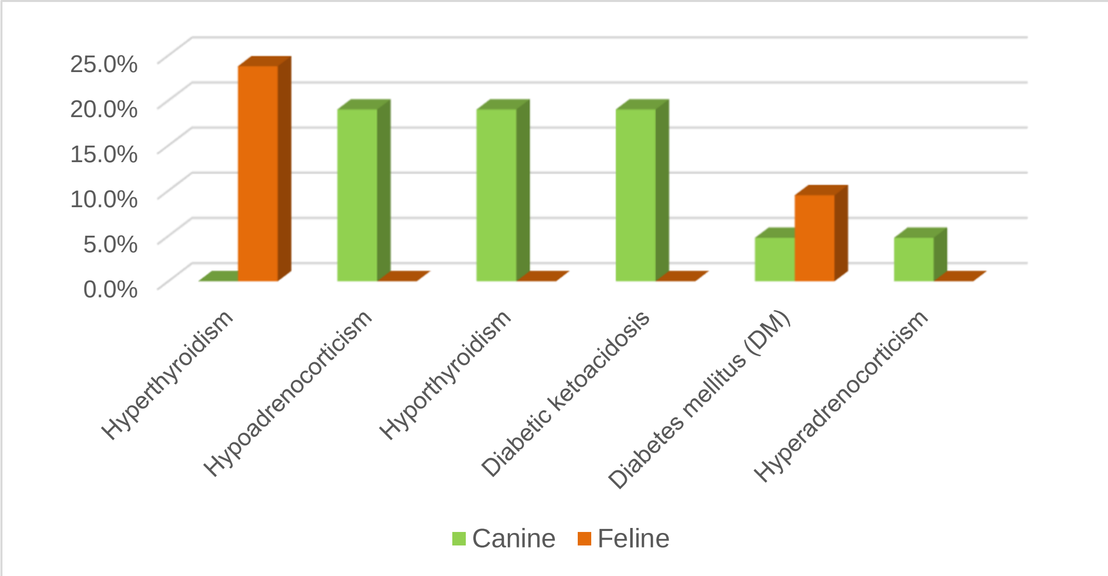
In these cases, the execution of more aggressive and invasive diagnostics such as MRI and CT, CSF analysis, serologic and genetic assays, and performance of brainstem auditory evoked responses (BAER) is warranted. MRI is the preferred diagnostic imaging modality for patients with central vestibular dysfunction. Differential diagnoses of the central vestibular disorder include hypothyroidism, intracranial neoplasia, meningoencephalitis, metronidazole toxicosis, and cerebrovascular disease (Rossmeisl, 2010).

2.2.3.7 Endocrinology

All the cases followed in the Endocrinology field are listed in Table 10 and schematically displayed in Graph 10, organized by condition and by species. The most prevalent condition observed was hyperthyroidism, representing 23.8% of the endocrinology cases assisted, followed by hypoadrenocorticism (19%), hypothyroidism (19%) and diabetic ketoacidosis (19%).

Table 10 - Distribution of the cases followed in the endocrinology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Endocrinology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Hyperthyroidism	0	0%	5	23.8%	5	23.8%
Hypoadrenocorticism	4	19%	0	0%	4	19%
Hypothyroidism	4	19%	0	0%	4	19%
Diabetic ketoacidosis	4	19%	0	0%	4	19%
Diabetes *mellitus* (DM)	1	4.8%	2	9.5%	3	14.3%
Hyperadrenocorticism	1	4.8%	0	0%	1	4.8%
Total	14	66.7%	7	33.3%	21	100%



Graph 10 - Distribution of the cases followed in the endocrinology specialty, expressed in fr (%).

Feline hyperthyroidism (FHT) is the most commonly diagnosed endocrinopathy in the domestic cat and represents one of the most critical diseases in feline practice (Carney et al., 2016; Graves, 2017; McLean et al., 2014).It is defined as a multi-systemic disorder induced by excessive active thyroid hormones production from an abnormally functioning thyroid gland (McLean et al., 2014). The abnormal function is generally induced by adenomatous hyperplasia of the thyroid tissue, leading to the formation of nodules that secrete thyroid hormone autonomously, escaping the control of the hypothalamus and pituitary gland. These nodules seldom demonstrate characteristics of malignancy and are considered benign endocrine tumors (Carney *et al.*, 2016; Graves, 2017). Some cats have a cystic enlargement of the thyroid gland without hyperthyroxemia (Carney *et al.*, 2016).

The causes of FHT in its current presentation are not yet understood (Carney *et al.*, 2016). Several studies have attempted to identify potential risk factors, but a single dominant factor has not been identified (McLean et al., 2014). Genetic, dietary, and environmental factors have been proposed (Carney et al., 2016; McLean et al., 2014).

Classic presenting symptoms of FHT include weight loss, polyphagia, polyuria, polydipsia, increased vocalization, agitation, increased activity, tachypnea, tachycardia, emesis, diarrhea, and unkempt appearance (Carney *et al.*, 2016).

The demonstration of persistently elevated thyroid hormone concentrations occurring concurrently with one or more of the typical clinical signs is necessary for the diagnosis of FHT (Carney *et al.*, 2016). Serum tT4 concentration is the most commonly used screening test (Graves, 2017), with results above reference intervals confirming the diagnosis of more than 91% of FHT cats (Peterson et al., 2001).

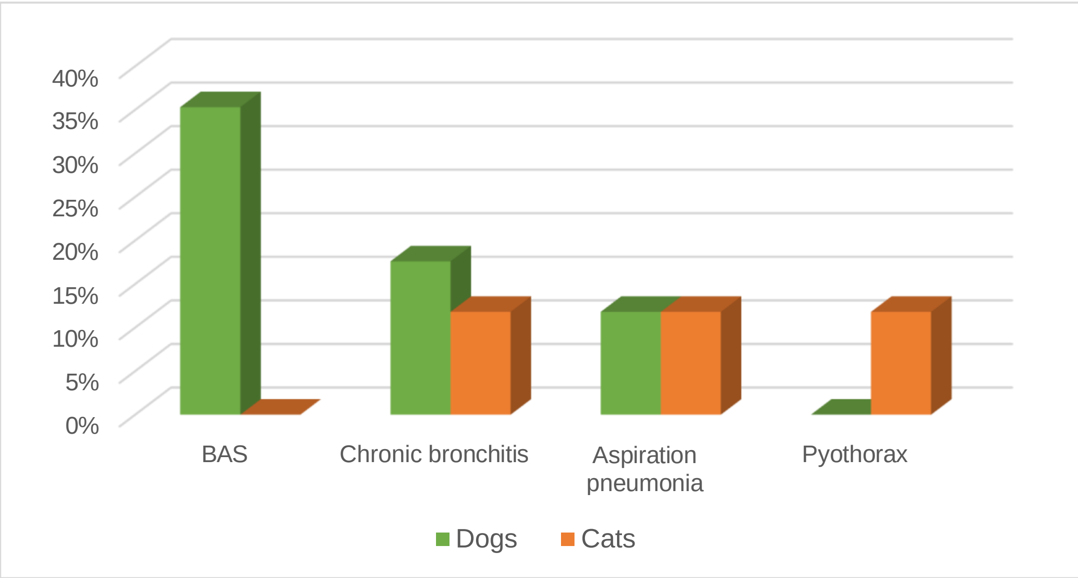
Treatment options for FHT include treatment with radioactive iodine, medical management with methimazole or carbimazole, surgical thyroidectomy, and dietary therapy using iodine-restricted food (Carney *et al.*, 2016).

2.2.3.8 Pneumology

All the cases followed in the pneumology field are listed in Table 11 and schematically displayed in Graph 11, organized by condition and by species. The most prevalent condition observed was brachycephalic airway syndrome (BAS), representing 35.3% of the cases assisted, followed by chronic bronchitis (29.9%), aspiration pneumonia (23.5%) and pyothorax (11.8%).

Table 11 - Distribution of the cases followed in the pneumology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Pneumology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
BAS	6	35.3%	0	0%	6	35.3%
Chronic bronchitis	3	17.6%	2	11.8%	5	29.4%
Aspiration pneumonia	2	11.8%	2	11.8%	4	23.5%
Pyothorax	0	0%	2	11.8%	2	11.8%
Total	11	64.7%	6	35.3%	17	100%



Graph 11 - Distribution of the cases followed in the pneumology specialty, expressed in fr (%).

Abnormally short and wider skull conformation (Dupré and Heidenreich, 2016) and primary anatomic changes of the upper airway such as stenotic nares, elongated and hyperplastic soft palate, hypoplastic trachea, and aberrant nasopharyngeal turbinates are the physical foundations of BAS (Aiken, 2021; Dupré and Heidenreich, 2016; Meola, 2013). These anomalies result in chronic partial upper airway obstruction and increased respiratory resistance, resulting in secondary complications including laryngeal and gastroesophageal disease and chronic bronchitis (Aiken, 2021; Dupré and Heidenreich, 2016). Breeds most commonly affected include English and French Bulldogs, Pugs and Boston Terrier (Dupré and Heidenreich, 2016).

Diagnosis of BAS is based on history, physical examination, imaging findings, endoscopic studies, and pharyngeal/laryngeal examination (Aiken, 2021).

Typical respiratory clinical signs may include snoring, stertor and stridor, coughing, exercise intolerance, hyperthermia, inspiratory dyspnea, cyanosis, and, in severe cases, syncopal episodes (Aiken, 2021; Dupré and Heidenreich, 2016; Meola, 2013). During periods of increased climate temperature, clinical respiratory signs aggravate, limiting exercise tolerance and lengthening exercise recovery time (Aiken, 2021). Because BAS is a progressive disease, clinical signs may vary from a slight increase in the respiratory effort to severe respiratory crisis due to airway obstruction and laryngeal collapse (Meola, 2013). Clinical signs tend to worsen with age (Aiken, 2021).

Medical therapy comprises cooling techniques, tranquilizers and nonsteroidal anti-inflammatory drugs (NSAIDs) administration, and oxygen therapy (Dupré and Heidenreich, 2016).

Although adjustment of the primary causes of BAS at an early age is preferable to limit secondary changes, older patients still benefit from surgical treatment (Aiken, 2021). Surgical techniques to treat BAS include: i) correction of stenotic nares via ala nasi amputation, alaplasty, alapexy, and vestibuloplasty; ii) staphylectomy and folded flap palatoplasty (FFP) for surgical treatment of elongated-hyperplastic soft palate and iii) turbinectomy and Laser-Assisted Turbinectomy (LATE) for correction of the aberrant nasopharyngeal turbinates (Dupré and Heidenreich, 2016).

In most cases, surgical treatment of secondary laryngeal disease is not necessary if nares and palate abnormalities are corrected (Dupré and Heidenreich, 2016). Correction of the upper airway obstruction can alleviate many of the gastrointestinal signs correlated to BAS; if not, additional testing may need to be performed to address them (Aiken, 2021).

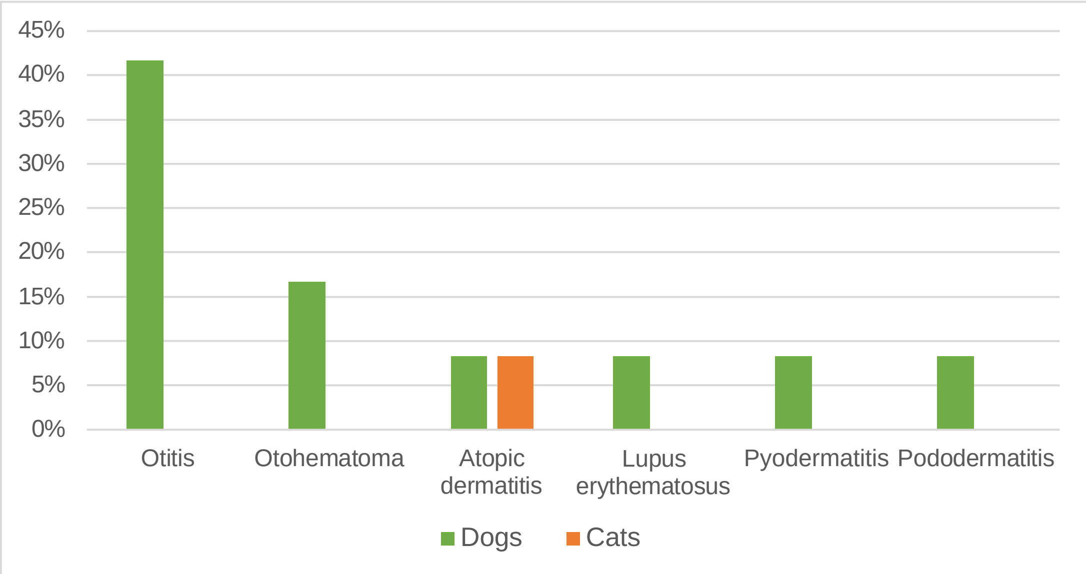
2.2.3.9 Dermatology

All the cases followed in the dermatology field are listed in Table 12 and schematically displayed in Graph 12, organized by condition and by species. The most prevalent condition observed was otitis, representing 41.7% of the cases assisted, followed by otohematoma (16.7%), and atopic dermatitis (16.7%).

Table 12 - Distribution of the cases followed in the dermatology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Dermatology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Otitis	5	41.7%	0	0%	5	41.7%
Otohematoma	2	16.7%	0	0%	2	16.7%
Atopic dermatitis	1	8.3%	1	8.3%	2	16.7%
Lupus erythematosus	1	8.3%	0	0 %	1	8.3%
Pyodermatitis	1	8.3%	0	0%	1	8.3%

Pododermatitis	1	8.3%	0	0%	1	8.3%
Total	11	91.7%	1	8.3%	12	100%



Graph 12 - Distribution of the cases followed in the dermatology specialty, expressed in fr (%).

Otitis, the inflammation of the ear canal, is one of the most frequent motives for consultation in small animal practice. Depending on the depth of the inflammatory reaction, otitis can be classified in otitis externa (OE), affecting the external auditory canal, otitis media (OM) when inflammation reaches the middle ear, and otitis interna (OI), which is the inflammation within the inner ear (Bensignor et al., 2017).

Otitis is a complex condition, with multiple factors predisposing, causing, and perpetuating the disease. Predisposing factors increase the probability of development of otitis, such as ear conformation, humidity accumulation, excessive hair growth in the auditory canal, incorrect cleaning, and irritant treatment; primary factors are the direct cause of inflammation, such like ectoparasites, allergic dermatitis, keratinization disorders, pyoderma, autoimmune dermatosis, presence of foreign bodies and neoformations; perpetuating factors support the continuation of the inflammatory state, like yeast, bacteria, epidermal and sebaceous hyperplasia, and ulceration (Bensignor et al., 2017).

The pathogenesis of otitis begins with primary inflammation of the auditory canal. Hyperplasia of the epidermis and ceruminous glands follows, resulting in excess production of cerumen. This environment favors the growth of commensal microorganisms such as Malassezia spp. and Staphylococcus spp., resulting in additional inflammation (Bensignor et al., 2017).

OE's clinical signs include head shaking, ear scratching, and, in some cases, ear canal erythema and malodorous secretion (Bensignor et al., 2017). The diagnostic approach should include patient history, otoscopic examination of both ears, starting with the supposed unaffected one, direct examination for parasites in cerumen, when suspected, cytology, and culture of the contents (Bensignor et al., 2017).

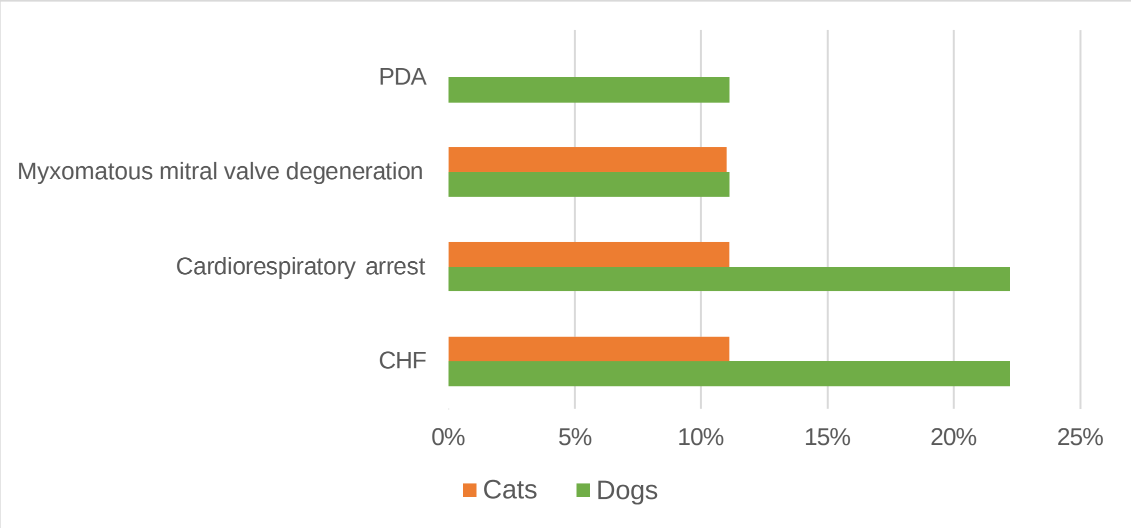
OE therapy goals include cleaning the ear canal, treating the specific primary causes, alleviating inflammation, and eliminating the microbial infection (Bensignor et al., 2017).

2.2.3.10 Cardiology

All the cases followed in the cardiology field are listed in Table 13 and schematically displayed in Graph 13, organized by condition and by species. The most prevalent condition observed was congestive heart failure (CHF) and cardiorespiratory arrest, both representing 33.3 % of the cases assisted, followed by myxomatous mitral valve degeneration (22.2%) and Patent Ductus Arteriosus (PDA) (11.1%).

Table 13 - Distribution of the cases followed in the cardiology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Cardiology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
CHF	2	22.2%	1	11.1%	3	33.3%
Cardiorespiratory arrest	2	22.2%	1	11.1%	3	33.3%
Myxomatous mitral valve degeneration	1	11.1%	1	11.1%	2	22.2%
PDA	1	11.1%	0	0%	1	11.1%
Total	6	66.7%	3	33.3%	9	100%



Graph 13 - Distribution of the cases followed in the dermatology specialty, expressed in fr (%).

PDA is the most common congenital heart condition detected in dogs, with female and toy/miniature breeds overrepresented (Broaddus and Tillson, 2010). Cats are also affected by this condition but more rarely than dogs (Beijerink et al., 2017).

The ductus arteriosus (DA) is an embryonic vessel that shunts blood away from the nonfunctional lungs back into the systemic circulation. After birth, the lungs become patent, and the DA is no longer needed. During this time, an increase in systemic oxygen tension and a decline in circulating prostaglandins lead to DA closure. In dogs with PDA, the DA fails to contract, resulting in blood flowing from the systemic circulation into the pulmonary circulation (left-to-right shunting), resulting in volume overload in the pulmonary system. This leads to the dilation of the pulmonary arteries and veins, left atrium, and left ventricle, followed by eccentric hypertrophy of the left side of the heart, culminating in left-sided CHF (Broaddus and Tillson, 2010).

Many dogs are suspected of having PDA when they present for routine puppy vaccinations, and a left-sided, continuous murmur is auscultated, and a palpable thrill is noted. Most dogs are asymptomatic or report mild exercise intolerance, poor body condition, stunted growth, and tachypnea (Beijerink et al., 2017; Broaddus and Tillson, 2010). Some puppies may succumb to heart failure secondary to PDA before the first veterinary examination (Beijerink et al., 2017).

PDA diagnosis is based primarily on cardiac auscultation, where typically, a loud murmur is heard. Less common findings are a systolic murmur and a faint diastolic murmur. “Water hammer” pulses can also be present. Thoracic radiography is beneficial for the evaluation of the anatomic changes consistent with PDA. Electrocardiography (ECG) should be executed to evaluate heart chamber enlargement and, echocardiography may help identify any other cardiac defects and confirm the diagnosis (Broaddus and Tillson, 2010).

Surgical mechanical occlusion of the PDA remains the mainstay of treatment in dogs (Broaddus and Tillson, 2010).

2.2.3.11 Hematology

All the cases followed in the hematology field are listed in Table 14, organized by condition and by species. The most prevalent condition observed was immune-mediated hemolytic anemia (IMHA) representing 57.1% of the cases assisted, followed by immune-mediated thrombocytopenia (42.9%).

Table 14 - Distribution of the cases followed in the hematology specialty, expressed in fi and fr (%).

	Dogs		Cats		Total	
Hematology	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Immune-mediated hemolytic anemia	4	57.1%	0	0%	4	57.1%
Immune-mediated thrombocytopenia	3	42.9%	0	0%	3	42.9%
Total	7	100%	0	0%	7	100%

IMHA is a condition characterized by immune destruction of erythrocytes coated with immunoglobulins, complement, or both, resulting in direct destruction or phagocytosis and consequence removal from systemic circulation (Mccullough, 2003).

Most dogs have non-specific signs consistent with the presence of anemia, such as tachycardia, tachypnea, and pale mucous membranes. Findings like yellow to orange discoloration of the feces and red urine are consistent with hemolysis (Piek, 2017).

Having identified anemia in a patient, the biomarkers of immune-mediated destruction and hemolysis should be assessed.

Prominent spherocytosis in dogs and patients that did not undergo blood transfusion, positive saline agglutination test by mixing four drops of saline with one drop of blood, and a demonstration of anti-erythrocyte antibodies, either by direct Coombs' test or flow cytometry, are consistent with signs of immune-mediated destruction (Garden *et al.*, 2019). Likewise, evidence of hemolysis include spherocytosis, hyperbilirubinemia, significant bilirubinuria, and icterus in the absence of decreased functional hepatic mass, obstructive cholestasis, or sepsis, hemoglobinemia and hemoglobinuria, and erythrocyte ghosts (Garden *et al.*, 2019).

Immunosuppressive treatment with prednisone or prednisolone should be started when IMHA diagnosis is reached. A second immunosuppressive drug may be introduced in the initial therapeutic to decrease the dosage of glucocorticoid required. These include azathioprine, cyclosporine, and mycophenolate mofetil. IV administration of immunoglobulin should be considered in dogs not responding to the treatment with two immunosuppressive drugs (Swann *et al.*, 2019).

The administration of packed red blood cells is recommended when dogs with IMHA display clinical features attributable to decreased tissue oxygen delivery (Swann *et al.*, 2019).

2.2.3.12 Reproduction

The only condition observed by the author in the reproduction specialty was pyometra, in 5 dogs.

Pyometra is a commonly diagnosed disorder in intact bitches and queens. It is a condition defined by the accumulation of inflammatory exudate in the uterine lumen, frequently after or during a period of strong progesterone influence.

The pathogenesis of the disease involves the combination of hormones and bacterial elements, although it is not fully understood. The predominant pathogen isolated in pyometra is *Escherichia coli*, but other bacteria can occur. Ascending infection from the gastrointestinal tract and vaginal flora are the most likely routes of infection, but hematogenic spread is also possible (Hagman, 2018).

Patients present with various signs associated with the genital tract and systemic illness. Systemic signs include anorexia, depression/lethargy, polydipsia, polyuria, tachycardia, tachypnea, weak pulse quality, and abnormal visible mucous membranes. A continuous or intermittent mucopurulent to hemorrhagic vaginal discharge is often present but absent if the cervix is closed (Hagman, 2018). Diagnosis is based on history and findings on physical and gynecologic examinations, hematology and blood biochemistry analyses, and ultrasonography or radiography of the abdomen (Hagman, 2018).

Surgical treatment by ovariohysterectomy after the patient is hemodynamically stabilized corresponds to the safest and most effective therapeutic since the source of infection and bacterial products are eliminated, and recurrence is permanently prevented (Hagman, 2018).

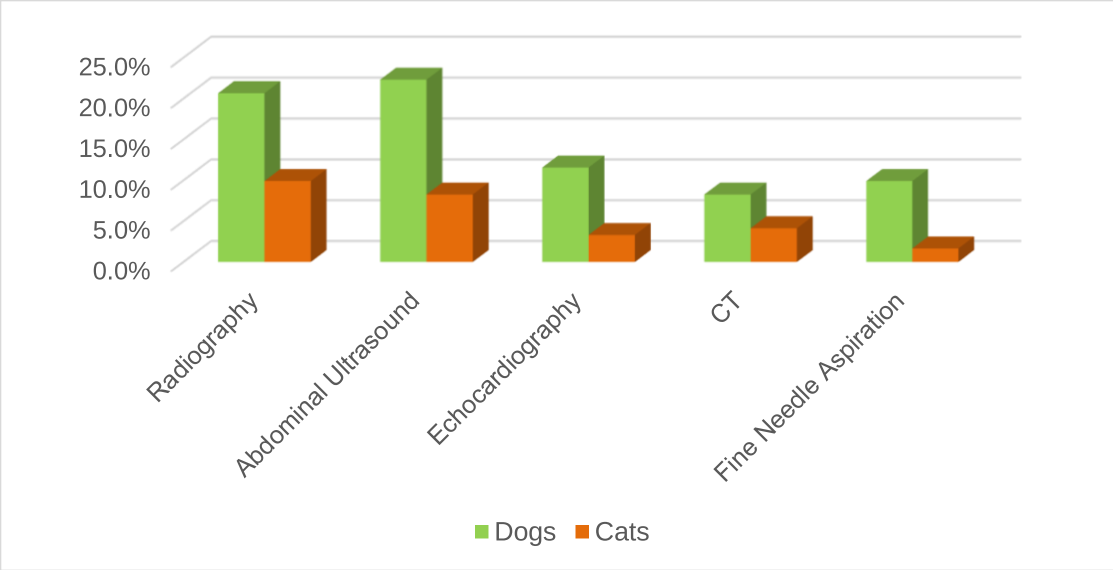
2.2.4 Imaging

Throughout the internship, the author was able to help and assist in the many modalities of imaging currently present in VetOeiras Veterinary Hospital. These include radiography, ultrasound and CT (Table 15 and Graph 14). In this category, although not an imaging study, all the FNA procedures observed are included, since they were all eco-guided.

The modalities most observed were radiography and abdominal ultrasound, both representing 30.6% of all the imaging studies. While the most observed exam in dogs was abdominal ultrasound (22.3%), in cats it was radiography (9.9%).

Table 15 – Distribution of the imaging studies assisted, divided by modality and species, expressed in fi and fr (%).

	Dogs		Cats		Total	
Imaging	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Radiography	25	20.7%	12	9.9%	37	30.6%
Abdominal ultrasound	27	22.3%	10	8.3%	37	30.6%
Echocardiography	14	11.6%	4	3.3%	18	14.9%
CT	10	8.3%	5	4.1%	15	12.4%
FNA	12	9.9%	2	1.7%	14	11.6%
Total	88	72.7%	33	27.3%	121	100%



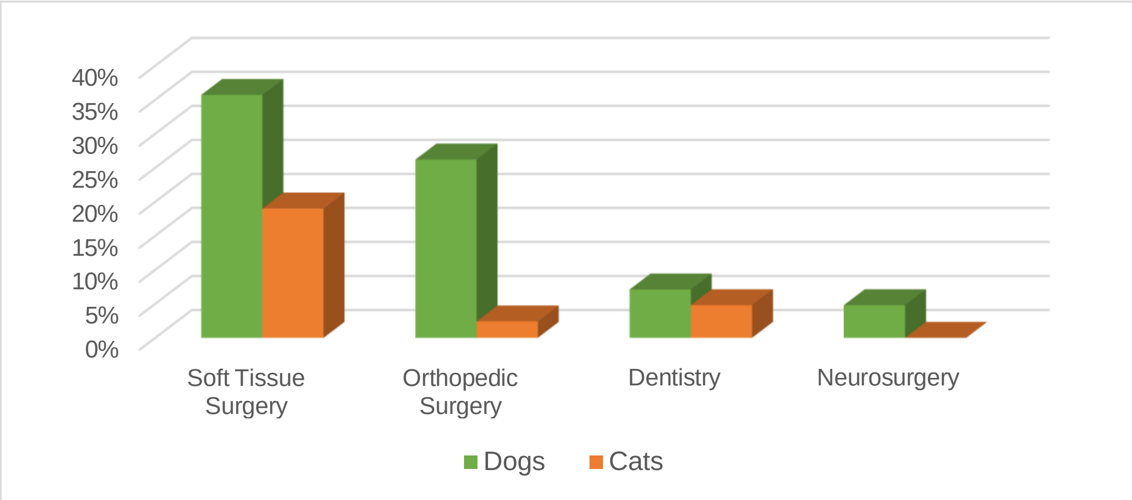
Graph 14 - Distribution of the imaging studies assisted, divided by modality and species, expressed in fr (%).

2.2.5 Surgical Practice

All the cases observed in surgical practice, a total of 42 procedures, were grouped by their specialties and by species (Table 16 and Graph 15). Soft tissue surgery was the most observed surgical specialty with 23 cases assisted, equivalent to 54.8%; followed by orthopedic surgery representing 28.6% of all surgeries observed. In surgical practice the most representative species dogs, with a total of 31 procedures, corresponding to 73.8%.

Table 16 - Distribution of cases followed in surgical practice, divided by specialty and species, expressed in fi and fr (%).

	Dogs		Cats		Total	
Surgical Practice	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Soft Tissue Surgery	15	35.7%	8	19.0%	23	54.8%
Orthopedic Surgery	11	26.2%	1	2.4%	12	28.6%
Dentistry	3	7.1%	2	4.8%	5	11.9%
Neurosurgery	2	4.8%	0	0%	2	4.8%
Total	31	73.8%	11	26.2%	42	100%



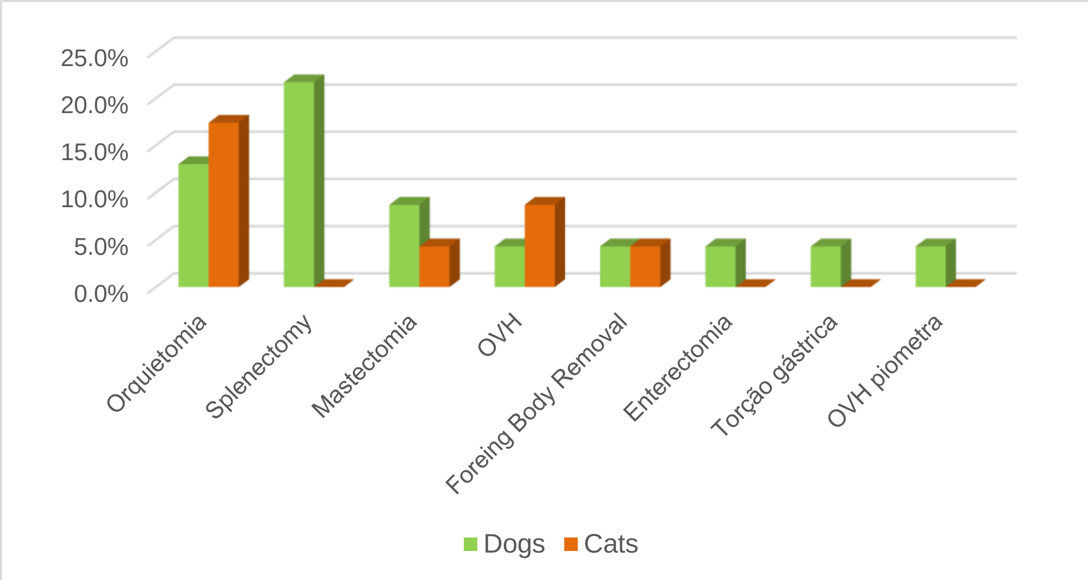
Graph 15 - Distribution of cases followed in surgical practice, divided by specialty and species, expressed in fr (%).

2.2.5.1 Soft Tissue Surgery

All the procedures observed in soft tissue surgery are listed in Table 17 and schematically displayed in Graph 16, organized by type of surgery and by species. The most observed surgery was orchiectomy, representing 30.4% of the procedures assisted, followed by splenectomy (21.7%) and mastectomy (13%).

Table 17 - Distribution of cases followed in soft tissue surgery, divided by specialty and species, expressed in fi and fr (%).

	Dogs		Cats		Total	
Soft Tissue Surgery	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Orchiectomy	3	13%	4	17.4%	7	30.4%
Splenectomy	5	21.7%	0	0%	5	21.7%
Mastectomy	2	8.7%	1	4.3%	3	13%
Ovariohysterectomy (OVH)	1	4.3%	2	8.7%	3	13%
Foreign body removal	1	4.3%	1	4.3%	2	8.7%
Enterectomy	1	4.3%	0	0%	1	4.3%
Gastric torsion	1	4.3%	0	0%	1	4.3%
OVH (pyometra)	1	4.3%	0	0%	1	4.3%
Total	15	65.2%	8	34.8%	23	100%



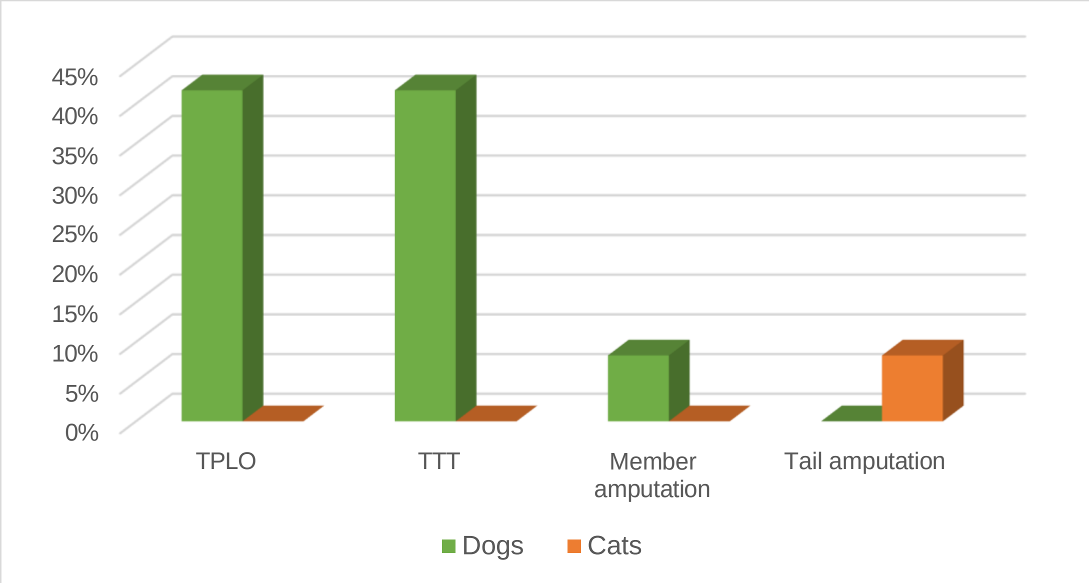
Graph 16 - Distribution of cases followed in soft tissue surgery, divided by specialty and species, expressed in fr (%).

2.2.5.2 ***Orthopedic Surgery***

All the procedures observed in orthopedic surgery are listed in Table 18 and schematically displayed in Graph 17, organized by type of surgery and by species. The most observed surgery was tibial plateau leveling osteotomy (TPLO) and tibial tuberosity transposition (TTT), both representing 41.7% of the procedures assisted, followed by member and tail amputation, both corresponding to 8.3%.

Table 18 - Distribution of cases followed in orthopedic surgery divided by specialty and species, expressed in fi and fr (%).

	Dogs		Cats		Total	
Orthopedic Surgery	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
TPLO	5	41.7%	0	0%	5	41.7%
TTT	5	41.7%	0	0%	5	41.7%
Member amputation	1	8.3%	0	0%	1	8.3%
Tail amputation	0	0%	1	8.3%	1	8.3%
Total	11	91.7%	1	8.3%	12	100%



Graph 17 - Distribution of cases followed in orthopedic surgery divided by specialty and species, expressed in fr (%)

2.2.5.3 ***Neurosurgery***

Only two procedures were observed in neurosurgery: ventral slot surgery and hemilaminectomy. Both surgeries were performed in dogs (Table 19).

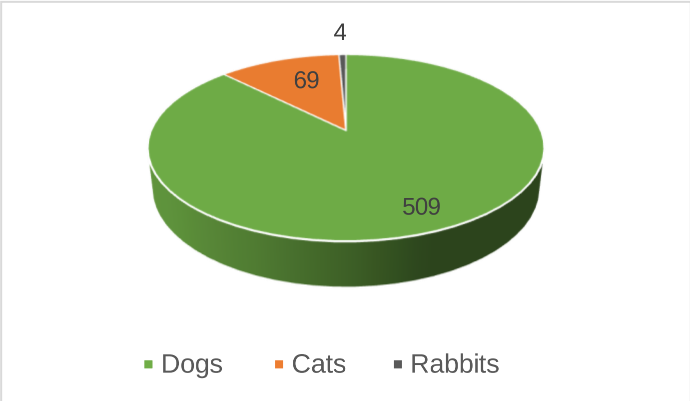
Table 19 - Distribution of cases followed in neurosurgery divided by specialty and species, expressed in fi and fr (%).

	Dogs		Cats		Total	
Neurosurgery	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Ventral slot	1	50%	0	0%	1	50%
Hemilaminectomy	1	50%	0	0%	1	50%
Total	2	100%	0	0%	2	100%

2.3 CASE-BY-CASE ANALYSIS OF THE OPHTHLMOLOGY INTERNSHIP

2.3.1 Distribution by species

During the ophthalmology internship, the author followed a total of 582 cases, of which 509 (87.5%) belong to dogs, 131 (11.9%) to cats and 4 (0.6%) to rabbits. The distribution of the cases followed by species is shown schematically in Graph 18.



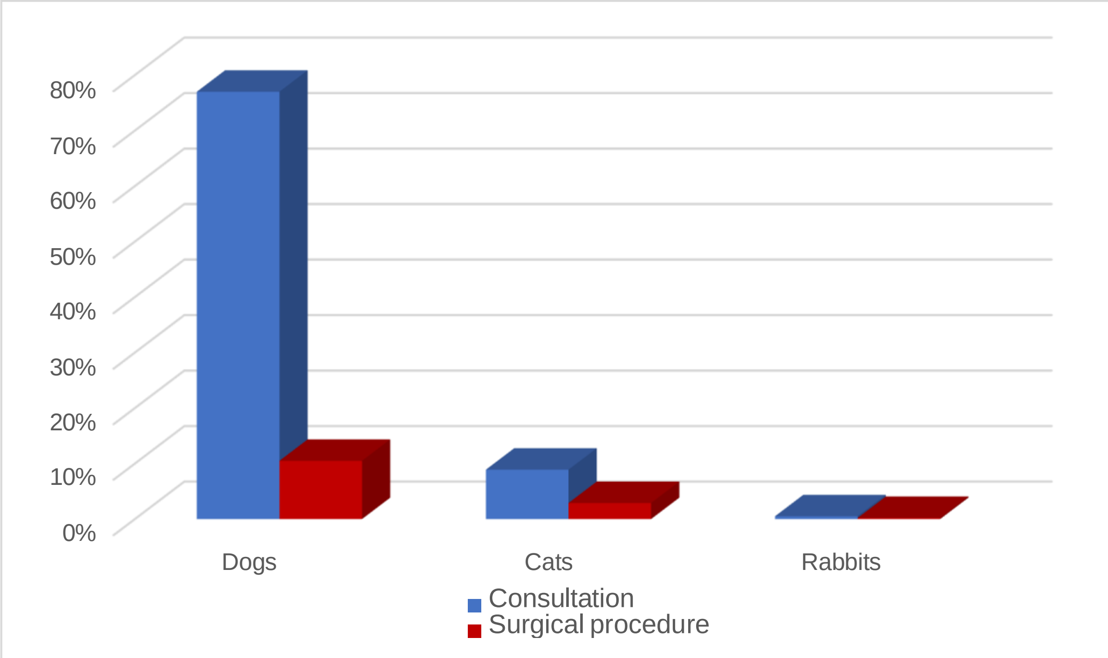
Graph 18 - Distribution of the cases followed by species, expressed in fi.

2.3.2 Distribution by clinical areas

The total cases were divided into two groups: consultations and surgical procedures. Table 20 and Graph 19 display the fi and fr (%) of the cases divided by area of practice and by species.

Table 20 - Distribution of the cases followed by species and are of practice, expressed in fi and fr (%).

	Dogs		Cats		Rabbits		Total	
Area of practice	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Consultation	448	77%	52	8.9%	3	0.5%	503	86.4%
Surgical procedure	61	10.5%	17	2.9%	1	0.2%	79	13.6%
Total	509	87.5%	69	11.9%	4	0.7%	582	100%



Graph 19 - Distribution of the cases followed by species and are of practice, expressed in fr (%).

2.3.3 Consultations

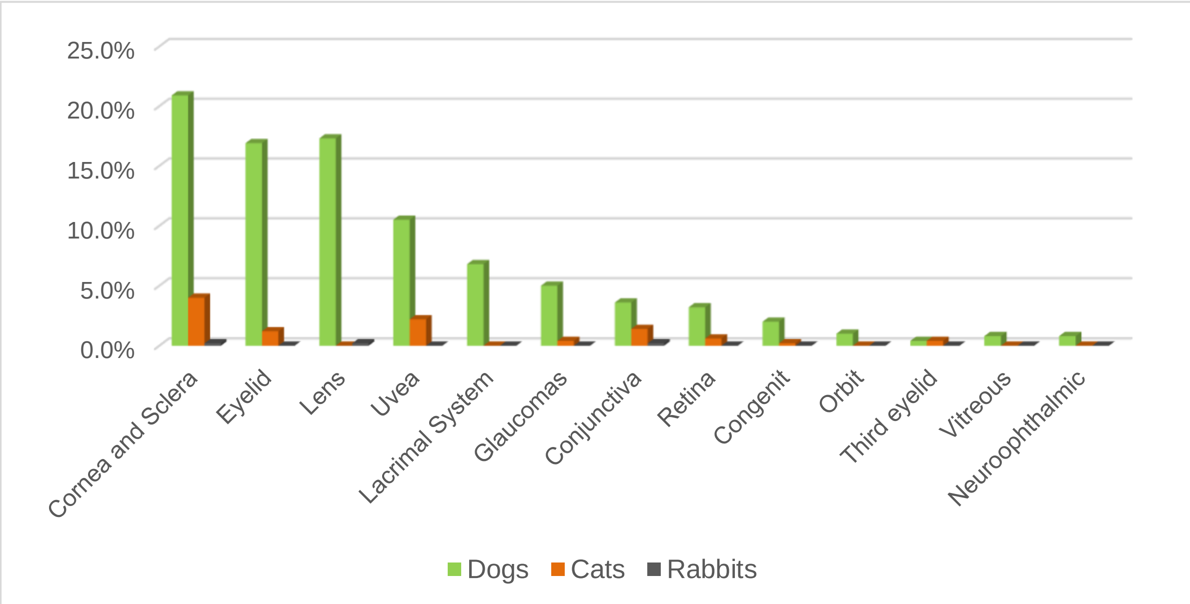
The cases accompanied in consultation were subdivided according to ophthalmological anatomical areas, as seen resumed in Table 21 and Graph 20.

The cornea and sclera were the anatomical locations where most conditions were observed, representing 25% of all the cases; these were followed by eyelids (18.1%), lens (17.5%) and uvea (12.7%). Despite the fact that the lens represented the third most common region, the author did not observe any lens pathology in the cats during her internship.

Table 21 - Distribution of the cases followed in consultation by species and anatomical area, expressed in fi and fr (%).

	Dogs		Cats		Rabbits		Total	
Ophthalmic consultation	fi	fr (%)	fi	fr (%)	fi	fr (%)	fi	fr (%)
Cornea and Sclera	105	20.9%	20	4%	1	0.2%	126	25%
Eyelid	85	16.9%	6	1.2%	0	0%	91	18.1%
Lens	87	17.3%	0	0%	1	0.2%	88	17.5%
Uvea	53	10.5%	11	2.2%	0	0%	64	12.7%
Lacrimal System	34	6.8%	0	0%	0	0%	34	6.8%
Glaucomas	25	5%	2	0.4%	0	0%	27	5.4%

Conjunctiva	18	3.6%	7	1.4%	1	0.2%	26	5.2%
Retina	16	3.2%	3	0.6%	0	0%	19	3.8%
Others	10	2%	1	0.2%	0	0%	11	2.2%
Orbit	5	1%	0	0%	0	0%	5	1%
Third Eyelid	2	0.4%	2	0.4%	0	0%	4	0.8%
Vitreous	4	0.8%	0	0%	0	0%	4	0.8%
Neuroophthalmic	4	0.8%	0	0%	0	0%	4	0.8%
Total	448	89.1%	52	10.3%	3	0.6%	503	100%



Graph 20 - Distribution of the cases followed in consultation by species and anatomical area, expressed in fr (%).

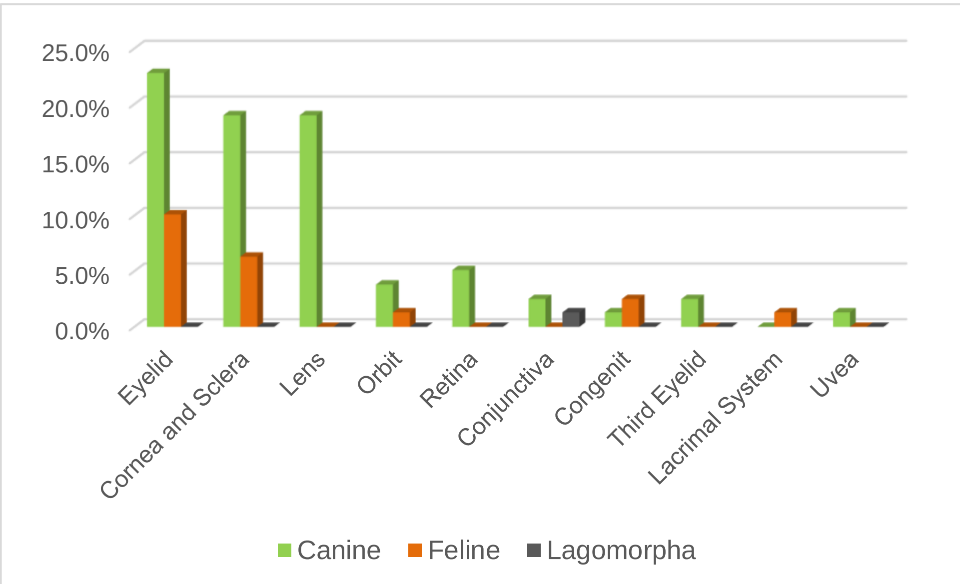
2.3.4 Surgical procedures

The cases accompanied in ophthalmic surgery were subdivided according to ophthalmological anatomical areas intervened, as resumed in Table 22 and Graph 21.

The eyelids were the anatomical location where most surgical procedures were observed, representing 32,9% of all the cases; these were followed by the cornea and the sclera (25,3%), and the lens (19%).

Table 22 - Distribution of the cases followed in surgical procedures by species and anatomical area, expressed in fi and fr (%).

	Dogs		Cats		Rabbits		Total	
Surgical procedures	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**	**fi**	**fr (%)**
Eyelid	18	22.8%	8	10.1%	0	0%	26	32.9%
Cornea and Sclera	15	19%	5	6.3%	0	0%	20	25.3%
Lens	15	19%	0	0%	0	0%	15	19%
Orbit	3	3.8%	1	1.3%	0	0%	4	5.1%
Retina	4	5.1%	0	0%	0	0%	4	5.1%
Conjunctiva	2	2.5%	0	0%	1	1.3%	3	3.8%
Others congenital diseases	1	1.3%	2	2.5%	0	0%	3	3.8%
Third Eyelid	2	2.5%	0	0%	0	0%	2	2.5%
Lacrimal System	0	0%	1	1.3%	0	0%	1	1.3%
Uvea	1	1.3%	0	0%	0	0%	1	1.3%
Total	61	77.2%	17	21.5%	1	1.3%	79	100%



Graph 21 - Distribution of the cases followed in consultation by species and anatomical area, expressed in fr (%).

3 COMBINED MIDLINE AND CORONAL RHYTIDECTOMY TECHNIQUE IN THE TREATMENT OF PSEUDOPTOSIS DUE TO REDUDANT FOREHEAD SKIN IN THE DOG

3.1 LITERATURE REVIEW

3.1.1 Eyelid anatomy and physiology

The eyelids are thin and mobile skin folds that are continuous with the facial skin (Meekins et al., 2021; Murphy et al., 2013) corresponding to the transition between the integumentary and the ophthalmological systems (Murphy et al., 2013). Each eye bears two palpebrae, a superior, upper or dorsal and an inferior, lower or ventral one (Stades and Woerdt, 2021). These two eyelids meet at the temporal and nasal ends of the eye to form the lateral and medial canthus, respectively. The medial canthus bears the lacrimal caruncle; it also contains two and five mm from the canthus, the superior and inferior lacrimal puncta in the bulbar surface of the eyelid margin. The lateral canthus is more acute than the medial counterpart. The palpebral fissure is the elliptical-shaped opening between the eyelids through which the globe contacts the environment, enabling light to come through (Murphy et al., 2013).

The superior eyelid is slightly larger and more mobile than the inferior one (Murphy et al., 2013; Stades and Woerdt, 2021).

3.1.1.1 Eyelid anatomy

The eyelids are histologically composed of four distinct layers (Figure 2 and Figure 3) (from superficial to deep): the skin, skeletal muscle, tarsus, and conjunctiva (Bettenay et al., 2018; Meekins et al., 2021).

The skin, the outermost layer, is an extension of the face's skin, which similarly contains hair, sebaceous glands, and sweat glands, even if modified (Meekins et al., 2021; Murphy et al., 2013). Eyelid movements require the skin on the eyelids to be thinner, more mobile, and more elastic than the skin in any other body part (Gelatt and Whitley, 2011). Eyelashes, or cilia, protrude on the upper eyelid in dogs in two to four irregular rows (Meekins et al., 2021; Stades and Woerdt, 2021). In addition to having a protective function, the cilia intensify eyelid sensitivity, thus increasing the speed of reflex blinking, protecting the globe against potentially harmful stimuli (Bettenay et al., 2018). The periocular skin and cilia are innervated by the mandibular and maxillary branches of the trigeminal nerve (CN V) (Bettenay et al., 2018). There are two types of glands associated with palpebral skin: Zeis's glands, rudimentary sebaceous glands that open into ciliary follicles in the superior eyelid, and Moll's glands or ciliary glands, modified apocrine sweat glands that open on the eyelid margin near the base of the eyelashes, or into the hair follicles or sebaceous glands (Bettenay et al., 2018; Meekins et al., 2021; Murphy et al., 2013).

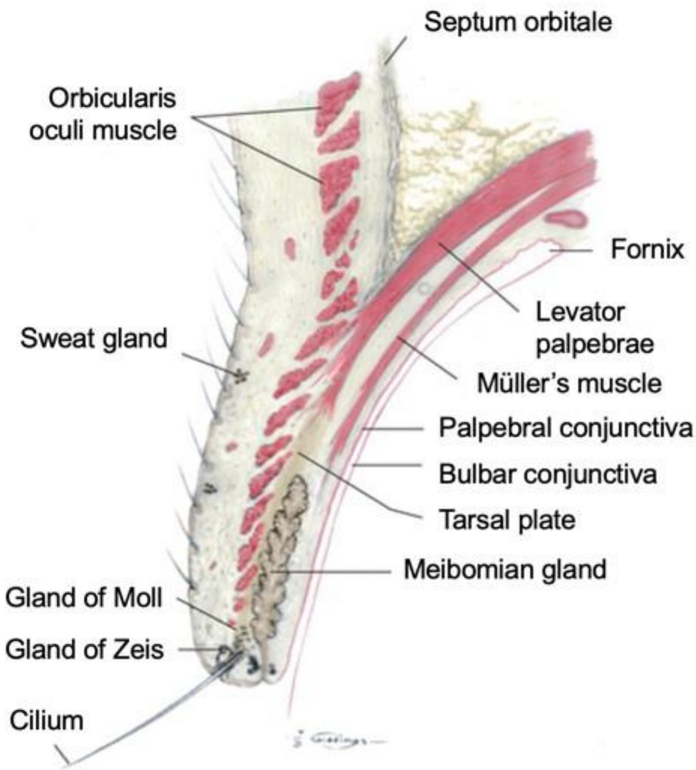


Figure 2 - Cross-section of the normal eyelid anatomy (adapted from Bettenay et al., 2018).

Under the skin layer, there is a collagenous stroma and striated muscle fibers, which form the orbicularis oculi muscle, the muscle responsible for the closing movement of the eyelids. Its fibers are arranged in a parallel fashion and extend over almost the entirety of the eyelids (Meekins et al., 2021).

The tarsus, a dense mass of connective tissue that separates the muscular layer from the palpebral conjunctiva (Meekins et al., 2021), provides the eyelid some rigidity (Bettenay et al., 2018) and a surface for muscle attachment (Stades and Woerdt, 2021). Much more developed in humans, the tarsus, or tarsal plate, is much less prominent or even absent in various domestic species, including dogs (Murphy et al., 2013). In the distal portion of the tarsal plate of both eyelids, the Meibomian glands, modified sebaceous glands, are inserted, which open immediately posterior to the mucocutaneous junction of the palpebral margin (Bettenay et al., 2018; Meekins et al., 2021; Murphy et al., 2013). These glands produce a secretion rich in phospholipids, called meibum, that constitute the superficial lipid layer of the precorneal tear film (Bettenay et al., 2018; Meekins et al., 2021). This secretion adds stability and reduces evaporation of the aqueous layer of the tear film (Bettenay et al., 2018; Stades and Woerdt, 2021). When the eyelid is everted, the openings of the Meibomian glands can be spotted as small white to grayish holes, that when seen macroscopically, appear as a thin line that runs in the length of the eyelid margin. This line represents a significant landmark in palpebral surgery, called the "*gray line*" (Bettenay et al., 2018; Murphy et al., 2013).

Finally, the palpebral conjunctiva is a mucous membrane that lines the innermost part of the eyelids, therefore, is in contact with the eyeball. The palpebral conjunctiva is composed of stratified squamous epithelium and Goblet cells (Murphy et al., 2013). The Goblet cells are responsible for the production of the mucin layer of the precorneal tear film (Maggs, 2018). The distribution of these cells in the conjunctiva is heterogeneous in the dog, with the zones of highest density being along the infra-medial and middle fornix and the inferior tarsal portion of the palpebral conjunctiva (Meekins et al., 2021). It is believed that, in domestic species, there are accessory lacrimal glands, referred to as conjunctival glands, that are present in the palpebral conjunctiva. In humans, these glands are called Krause and Wolfring glands, and they are located in the posterior lining of the eyelids and the conjunctival fornix, respectively (Meekins et al., 2021).

3.1.1.2 Eyelid musculature and innervation

The movement of blinking, the closure and opening of the eyelids, requires cooperation between various opposing groups of muscles and sensorial (afferent pathway) and motor nerves (efferent pathway) (Bettenay et al., 2018).

The ophthalmic branch of the CN V is responsible for the sensory innervation of the upper eyelids, cornea, and conjunctiva, whereas the lower eyelid receives its sensory innervation via the maxillary branch of the same cranial nerve (Bettenay et al., 2018; Stades and Woerdt, 2021). The CN V is responsible for the afferent pathway of the palpebral reflex (Stades and Woerdt, 2021).

This sensory nerve provides extreme eyelid, corneal and conjunctival sensitivity, regulating routine and reflexive blinking, detecting menaces and noticing corneal dryness (Bettenay et al., 2018; Stades and Woerdt, 2021).

The primary muscle responsible for eyelid closure is the *orbicularis oculi* muscle (Bettenay et al., 2018; Meekins et al., 2021). The *orbicularis oculi* muscle is innervated by the palpebral nerve, a branch of the facial nerve (CN VII) (Bettenay et al., 2018; Stades and Woerdt, 2021). This muscle encloses the palpebral fissure, and it is anchored to the orbit wall medially by the medial palpebral ligament and laterally by the retractor *anguli oculi lateralis* (Bettenay et al., 2018). These attachments sustain the elliptical configuration of the palpebral fissure and prevent it from becoming circular when *orbicularis oculi* muscle contraction (Bettenay et al., 2018; Meekins et al., 2021; Murphy et al., 2013). The malfunction of the medial palpebral ligament and the retractor *anguli oculi lateralis* can lead to medial or lateral canthal entropion, respectively (Bettenay et al., 2018).

Opening of the eyelids requires relaxation of the *orbicularis oculi* muscle, elevation of the upper eyelid, and depression of the lower eyelid (Bettenay et al., 2018; Meekins et al., 2021). The main elevators of the upper eyelid are the *levator palpebrae superioris* muscle and the Müller's muscle. The former begins near the optic foramen in the orbital apex (Bettenay et al., 2018; Meekins et al., 2021) and inserts in the tarsus (Meekins et al., 2021), and it is innervated by the oculomotor nerve (CN III). The Muller's muscle is sympathetically innervated and lies posterior to the *levator palpebrae superioris*. Less powerful elevators are the *levator anguli oculi madialis* and the *frontalis* muscle, innervated by the palpebral nerve (Bettenay et al., 2018).

The muscle responsible for lower eyelid depression is the Malaris muscle, innervated by the dorsal buccal nerve, a branch of the CN VII (Bettenay et al., 2018).

To conclude, the CN V is responsible for the afferent portion of the palpebral reflex, and the CN VII is responsible for the efferent portion of the same reflex (Stades and Woerdt, 2021). Interference with the motor or sensory eyelid innervation may result in severe disease of the cornea (Bettenay et al., 2018).

3.1.1.3 Eyelid blood supply and lymphatic drainage

The eyelids receive their blood supply primarily through the medial and lateral palpebral arteries. The branches of the external ethmoidal artery provide additional blood supply to both superior and inferior eyelids plus the lateral canthus. The medial facet of the eyelids is also supplied by a branch of the infraorbital artery, the malaris artery, whose branches anastomose with the inferior palpebral artery, transverse facial artery and branches of the external ophthalmic artery (Stades and Woerdt, 2021).

The lymphatic drainage of the palpebrae is primarily done by the parotid lymph node and the mandibular lymph nodes (Stades and Woerdt, 2021).

3.1.1.4 Eyelid function

The eyelids have numerous functions that are essential for pain-free physiological vision (Bettenay et al., 2018): (1) they act as a mechanical barrier that protects the eyes from the light, debris, and other physical threats that can damage the globe; (2) they have a fundamental role in the production of the oily layer of the precorneal tear film (PTF), via the Meibomian glands, limiting the dissection of the PTF; (3) they distribute the PTF evenly over the corneal surface and (4) the blink movement directs the tear to the nasolacrimal apparatus through a zipper-like movement, from the lateral canthus to the medial one (Bettenay et al., 2018; Stades and Woerdt, 2021); (5) finally, the eyelids are also part of the "*lacrimal-pump*" system; when contraction of the *orbicularis oculi* muscle occurs, negative pressure within the lacrimal sac is created, drawing tears; when contraction stops, the pressure is placed on the sac, forcing tears down the nasolacrimal duct (Bettenay et al., 2018).

3.1.2 Eyelid pathologies

Positional and functional eyelid anomalies can lead to chronic irritation of the cornea and conjunctiva. Chronic nonulcerative keratitis, corneal ulceration, pigmentation, and fibrosis are expected consequences of chronic irritation. Loss of vision or even loss of the globe may be an outcome. (Cairó *et al.*, 2018; Woerdt, van der, 2004)

3.1.2.1 Ptosis and pseudoptosis

Blepharoptosis, often abbreviated as ptosis, refers to an abnormally low upper eyelid compared to its normal anatomic positioning, narrowing the vertical aspect of the palpebral fissure, and covering part of or all the visual axis (Díaz-Manera et al., 2018; Finsterer, 2003; SooHoo et al., 2014; Stades and Woerdt, 2021). In the dog, it is considered a correct eyelid position when the eyelid margins cover the dorsal and ventral external limbi, while the palpebral fissure is fully open, and the eye is looking forward. The eyelid margins must align well with the curvature of the orbit and have a good apposition with the cornea (Figure 3) (Stades and Woerdt, 2021).

Figure 3 – Correct eyelid conformation and position in the dog (courtesy of Dr. Cristina Seruca).

Truly acquired ptosis results from superior eyelid retractors disorder, the *levator palpebrae superioris* or Müller's muscle, or both, and is best classified according to its primary cause. These include mechanical, myogenic, neurogenic, and aponeurogenic origin (Lyon and Khan, 2008). In human medicine, ptosis is classified according to multiple criteria: onset age, etiology, and severity. According to the age of onset, ptosis can be congenital or acquired. The blepharoptosis is considered congenital if it manifests within the first year of life (Finsterer, 2003; SooHoo *et al.*, 2014). It can be observed as unilateral or bilateral and with or without other ocular or systemic disorders (Díaz-Manera et al., 2018; Finsterer, 2003; SooHoo et al., 2014).

In veterinary medicine, truly acquired ptosis is frequently neurogenic. Ptosis can result from dysfunction of the CN III or CN III motor nucleus with denervation of the secondary *levator palpebrae superioris* muscle, as in cavernous sinus and orbital fissure syndrome; from sympathetic innervation dysfunction with secondary loss of tone of the Müller's muscle, as in Horner's syndrome (Ofri, 2018; Stades and Woerdt, 2021; Zwueste and Grahn, 2019). Other causes of neurogenic ptosis are dysautonomia, hemifacial spam (Ofri, 2018), midbrain syndrome, cranial dysinnervation syndrome (Webb and Cullen, 2021), and Aujeszky's Disease (Monroe, 1989; Webb and Cullen, 2021). A study by Valentine et al. in 1988 described five malignant intracranial germ cell tumors arising in the suprasellar region, with two of them causing ptosis (Valentine *et al.*, 1988).

Pseudoptosis, which is not a form of truly acquired ptosis, is the drooping of the superior eyelid despite normal *levator palpebrae superioris* or Müller's muscle function and innervation (Beard, 1989). Dermatochalasis, hypotropia, and orbital volume disturbances, such as microphthalmos, enophthalmos, phthisis bulbi, and anophthalmos, are common causes of pseudoptosis in human medicine. (Lyon and Khan, 2008)

In veterinary medicine, pseudoptosis is frequently the result of excessive forehead skin, commonly referred to as brow droop. Other causes include enophthalmos (Ofri, 2018) and myxedema in hypothyroid dogs (Mooney, 2017).

To the author’s knowledge, in veterinary medicine, the term pseudoptosis has only been used by Cairó et al. in 2018 to describe blepharoptosis due to reluctant frontal skin and brow droop. In veterinary medicine literature, the term ptosis is used to describe upper eyelid droop, independently of the origin.

The association between pseudoptosis and entropion of the upper eyelid is frequently observed in breeds with reductant forehead skin. Examples of these breeds include the Shar-Pei, Chow Chow, Bloodhound, Mastiff, Basset Hound, English Cocker Spaniel, French bulldog, English bulldog, Saint Bernard, Great Dane, and Pug (Cairó et al., 2018; Stades and Woerdt, 2021; Woerdt, 2004). The weight of the abundant skin causes blepharoptosis of the upper eyelid and can exacerbate chronic irritation caused by the entropion. Vision impairment can occur in severe cases (Woerdt, van der, 2004).

Pseudoptosis can be aggravated by big and heavy ear pinnae, especially when the head is turned towards the ground. This is a feature in several breeds such as the Bloodhound, Basset Hound, English cocker spaniel (ECS), Clumber spaniel and St. Bernard (Bedford, 1990; Stades and Woerdt, 2021). Due to the weight of the ears, the palpebral fissure is displaced ventrally and masks the globe, affecting sight (Bedford, 1990; Stades and Woerdt, 2021). This is usually accompanied by inferior and superior lateral entropion as well as inferior central ectropion (Stades and Woerdt, 2021).

Pseudoptosis is usually associated with loss of sight, superior and inferior entropion, ectropion, exposition of the nictitating membrane and lower palpebral conjunctiva, impaired tear film drainage and ocular surface disease.

Entropion

Entropion is the inner rolling of all or parts of the eyelid, in which the margin or the eyelid skin contacts the conjunctiva or corneal surface or both (Bettenay et al., 2018; Meekins et al., 2021). Regarding etiology, entropion can be classified as conformational, spastic, cicatricial, or after alterations of the eye position or size (Bettenay et al., 2018). In terms of severity it can also be classified in three degrees: 1) mild, when the margin is inverted up to 45 degrees; 2) moderate when there is an inversion of approximately 90 degrees; and 3) severe when the margin is 180 degrees inward (Meekins et al., 2021).

Anatomical abnormalities of the eyelids are the defining feature of conformational entropion. Entropion is a frequent eyelid abnormality in the dog, which in most cases affects both eyes. The lower eyelids are more frequently affected when compared with the upper eyelids. When the latter are affected, it is usually associated with breeds with heavy and prominent brows, like Bloodhounds, Shar-pei, or Chow Chow. It is believed to be a hereditary condition in many breeds. Conformational entropion usually manifests after total growth as the cranium and the facial skin gain adult conformation, especially in breeds with significant periocular skin (Bettenay et al., 2018).

Spastic entropion develops due to spastic contraction of the *orbicularis oculi* muscle induced by painful conditions like ulcerative or non-ulcerative keratitis, glaucoma, and uveitis. Because entropion is, by definition, always associated with trichiasis to some extent, spastic entropion is always an element of all cases of entropion. Thus, estimation of the relative contribution of the spastic component is of great importance when planning surgical treatment. A complete ophthalmic examination should always be performed as well as a comparison of entropion before and after topical anesthesia. Treatment of any condition contributing to blepharospasm should be pursued before surgical correction of entropion (Bettenay et al., 2018).

The result of entropion is chronic ocular surface irritation leading to tearing or mucoid discharge and/or purulent discharge, blepharospasm, conjunctival hyperemia and chemosis, non-ulcerative keratitis with fibrosis, and pigment deposition. In severe cases, it can lead to corneal ulceration, and even perforation, with loss of the eyeball and vision (Bettenay et al., 2018).

3.1.3 Pseudoptosis management

The management of pseudoptosis due to redundant forehead skin is surgical. Different approaches have been described depending on the breed, severity, and other morphologically based underlying causes (Stuhr *et al.*, 1997).

Techniques for pseudoptosis repair have been described in the veterinary medicine literature and include i) the Stades procedure (Stades, 1987; Stades and Boeve, 1987), ii) brow tacking (Holmberg, 1980; Lenarduzzi, 1983; Moore and Constantinescu, 1997), iii) brow suspension with various suture materials (Cairó *et al.*, 2018; Kirschner, 1994; Willis *et al.*, 1999) iv) and rhytidectomy procedures (Bedford, 1990; Blogg, 1980; Kasa and Kasa, 1979; Mccallum and Welser, 2004; Steinmetz, 2015; Stuhr *et al.*, 1997).

For mild cases of pseudoptosis, the most common surgical procedure is the local removal of eyelid skin with the Celsus-Hotz procedure with or without lateral canthoplasty (Mccallum and Welser, 2004).

3.1.3.1 Rhytidectomy procedures

The term rhytidectomy is derived from the Greek word '*rhytis*' meaning wrinkle, and '*ektome*' meaning excision: skin excision to remove wrinkles (Mccallum and Welser, 2004). While in human medicine, facelifts are frequently performed to improve aesthetics, the adaptation of this technique in veterinary medicine serves to restore the visual axis and aids in the correction of the entropion (Mccallum and Welser, 2004).

In 1980, Blogg described the first coronal rhytidectomy technique in veterinary medicine (Blogg, 1980). He proposed the transversal excision of the redundant skin in the occipital crest to relieve the extra skin pressure over the eyelids. Since then, few case reports have described several rhytidectomy techniques for the resolution of pseudoptosis: midline rhytidectomy (Bedford, 1990), stellate rhytidectomy (Stuhr *et al.*, 1997), coronal rhytidectomy combined with deep plane walking sutures (Mccallum and Welser, 2004), and shared rhytidectomy continued to lateral canthoplasty (Steinmetz, 2015).

Rhytidectomy techniques have several disadvantages including prolonged surgical time, potential scaring after large surgical incisions, and change in facial appearance. All rhytidectomy techniques require extensive facial skin excision and some owners may be reluctant to lose the characteristic look of the breed (Cairó *et al.*, 2018).

Midline (or frontal) rhytidectomy

In 1990, Bedford proposed an alternative rhytidectomy technique to that described by Blogg in 1980. The goal was to permanently restore the palpebral fissure by lifting it caudally to its anatomical position. This was to be achieved through surgical wound closure after extensive removal of “loose skin” in the dorsal cervical region, caudal to the pinnae (Bedford, 1990).

The method describes an elliptical-shaped longitudinal excision, which extends anterior to the medial canthi until posterior of the caudal limit of the nuchal crest (Bedford, 1990). The surgical excision is then sutured in two planes: interrupted sutures for the subcutaneous tissue and interrupted horizontal mattress suture for the skin. By closing the surgical defect, the palpebral fissure is repositioned in a physiological anatomical position and an unobstructed visual axis is accomplished.

The procedure reported excellent short-term success; according to Bedford, the visual axis was no longer obstructed and inferior ectropion was relieved (Figure 4C and 4D).

Complications of scar elongation due to the heavy weight of the ears and prominent scarring defect at the excision site were described in approximately 10% of the patients.

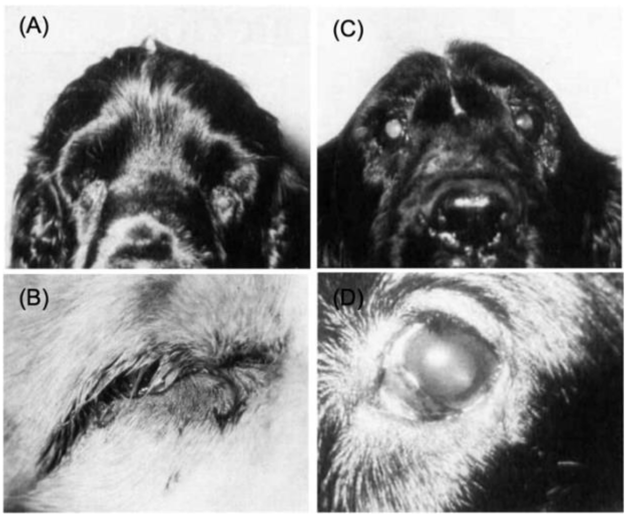


Figure 4 – **(A)** Picture of a three-year-old and **(B)** two-year-old ECS with severe pseudoptosis. **(C)** and **(D)**: Five weeks post midline rhytidectomy palpebral fissure appearance in ECS. Note the midline scaring present at the site of excision in **(C)**. (Adapted from Bedford, 1990)

Stellate rhytidectomy

In 1997, Stuhr et al. suggested, in a case report, an alternative approach to the rhytidectomy technique involving removing skin from the dorsal region of the head in a stellate pattern. The objective was to relieve the downward forces exerted by the extensive facial folds present in the Shar-Pei breed and resolve the upper eyelid entropion.

The stellate pattern is the product of observing the natural stress lines that radiated from the grasp and dorsal pull of the skin on the crown of the head preoperatively (Figure 5). This grasp permitted the estimation of the amount and shape of skin that needed to be removed to elevate the eyelids to their desired position.

Each ray observed represents an ellipse-shaped area of skin that needs to be excised. The surgical excisions are then closed in two planes: a continuous suture pattern for the subcutaneous and subcuticular tissue, using 4-0 polyglactin (Vicryl; Ethicon, Inc., Somerville, NJ) starting from the tip of the spoke and progressing to the center; and a simple or cruciate interrupted suture pattern for the skin, using 4-0 polypropylene (Prolene; Ethicon, Inc., Somerville, NJ). The central hub is sutured with a modified three-point suture pattern, using 4-0 polypropylene (Prolene; Ethicon, Inc., Somerville, NJ) (Stuhr *et al.*, 1997).

Figure 5 - Schematic representation of the natural stress lines (stellate pattern) which form by traction of the skin dorsally **(Stuhr *et al.*, 1997)**.

According to Stuhr et al., surgical wound healing occurred without problems, the main complaints were resolved (blepharospasm and serous ocular discharge), and complete blink was observed in both eyes. However, infra-lateral entropion was maintained (Stuhr *et al.*, 1997).The owners were pleased with the overall aesthetics. Ten months postoperatively, the Shar-Pei was reported to have an excellent cosmetic result, no signs of irritation, and no additional surgery was warranted.

The advantage of this technique in comparison with others described at the time of this case report, according to Stuhr et al., is that by removing skin ellipses in various areas of the head (stress lines), including the region caudal to the ears, opposed to just the brow skin, diminishes the chances of relapse because it negates the forward falling of skin.

Disadvantages include length of surgical time, aesthetics that are not in accordance with the breed standard, and residual scarring (Stuhr *et al.*, 1997).

Coronal rhytidectomy

In 2004, Mccallum and Welser described, in a case report, the execution of coronal rhytidectomy along with deep fixation suture, combined with modified Celsus-Hotz and lateral canthoplasty, for the resolution of pseudoptosis and superior entropion, in a 9-month-old female spayed Bloodhound, the main complaint being vision loss.

Preoperatively, the skin at the occipital crest was pulled dorsally in order to observe the natural tension lines of the brow; these radiated in a primarily sagittal plane, extending from the base of each ear, centered at the occipital crest with a bias rostrally (Mccallum and Welser, 2004). It was realized that, even by removing the tension resulting from the excessive skin, it would be necessary deep plane fixation by means of walking sutures and additional eyelid surgery (Mccallum and Welser, 2004).

The coronal rhytidectomy technique used comprises the excision of an elliptically shaped area of skin, from one ear to the other and from the occipital crest to the eyebrows (Figure 6A). A total of eight deep plane walking sutures, using 2-0 polydioxanone (PDS, Ethicon, Inc, Somerville, NJ, USA) were placed (Figure 6B). The surgical excision was closed in two planes: the subcuticular layer was closed with simple interrupted suture pattern using 3-0 polydioxanone (PDS, Ethicon, Inc, Somerville, NJ, USA) and the skin was closed using a cruciate suture pattern, using 3-0 nylon. Subsequently, a lateral canthoplasty and a modified Celsus-Hotz technique with a five millimeter tapered resection were performed (Mccallum and Welser, 2004).

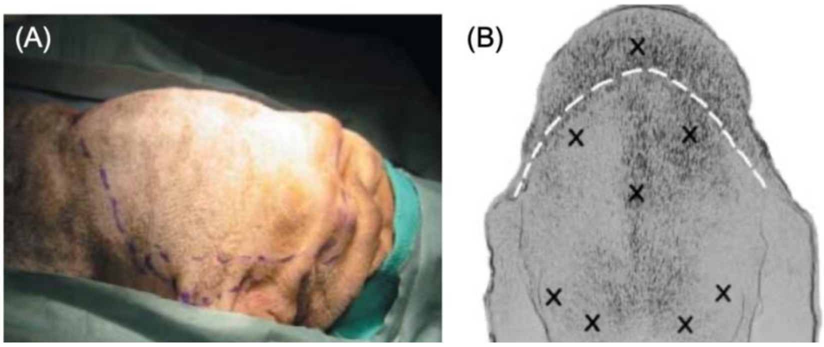


Figure 6 – (A) Intraoperative partial outline of the portion of skin to be removed in a right lateral view. **(B)** Schematic representation of the location of the deep plane walking sutures (represented by X) and incision line (represented by white dashed line) in a dorsal view (Mccallum and Welser, 2004).

In this case, multiple deep plane walking sutures were used to address the poor connection between the parietal and frontal fascia layer and the skin in the Bloodhound breed. The walking sutures were used to promote the adhesion between the underlying periosteum and overlying skin through fibrosis formation. Furthermore, these sutures provided a tension-free skin closure (Mccallum and Welser, 2004).

Postoperative reassessments revealed an unobstructed visual axis, comfortable eyes, and uneventful healing of the sutures in rhytidectomy and eyelid surgery. One week after surgery, a superficial pyoderma in the outer pinna and otitis externa in both ears was diagnosed in the first recheck. These findings were justified as the result of the bandage performed to remove the weight that the ears would bear in the rhytidectomy suture. The dressing was removed, and the pyoderma and otitis were treated, which both resolved within a week.

In the final recheck reported, at five weeks after surgery, the sutures were completely healed and the visual axis remained unobstructed, even in cervical ventroflexion.

Reported advantages include the fact that the incision is far from the face, improving the aesthetic outcome. However, in the incision, a mixture of hair of different colors and textures was noticed, which could negatively affect the aesthetic terms.

Shared rhytidectomy continued with lateral canthoplasty

In 2015, Steinmetz described a shared rhytidectomy continued with lateral canthoplasty in a 3.5-year-old male Neapolitan Mastiff presented with complaints of chronic bilateral purulent discharge and signs of loss of sight, secondary to pseudoptosis (Figure 7B).

In this technique, a crescent-shaped section of skin is incised in the dorsal periocular area in both eyes. The first incision, the dorsal incision, starts dorsomedial to the medial canthus and extends, in an arch dorsal to the upper eyelid, to end in a point ventrolateral to the lateral canthus. After this, the incision continues sharply upwards and ends at the lower eyelid margin, in the medial to lateral third section (Figure 7A). The second incision, the crescent-shaped ventral incision, begins at the same point as the dorsal incision and extends laterally, almost parallel to the upper eyelid where it ends in the medial section of the lateral third of the upper eyelid (Steinmetz, 2015).

After skin excision of the shape created by the incisions, which includes the lateral canthus and one-third of the superior and inferior eyelid margin, the lateral canthus is sutured using the figure of eight suture pattern, followed by the closure of the remaining surgical defect (Steinmetz, 2015).

Short-term (ten-day postoperative assessment) and medium-term (ten-month postoperative assessment) revealed an unobstructed visual axis and undisturbed blinking movement. However, conjunctival hyperemia and significant superior eyelid cicatricial ectropion was present (Figure 7C) (Steinmetz, 2015).

This technique attempts to resolve pseudoptosis, macroblepharon, superior eyelid entropion, lower eyelid entropion-ectropion in one procedure, through skin excision, palpebral fissure shortening and lateral canthus stabilization (Steinmetz, 2015).

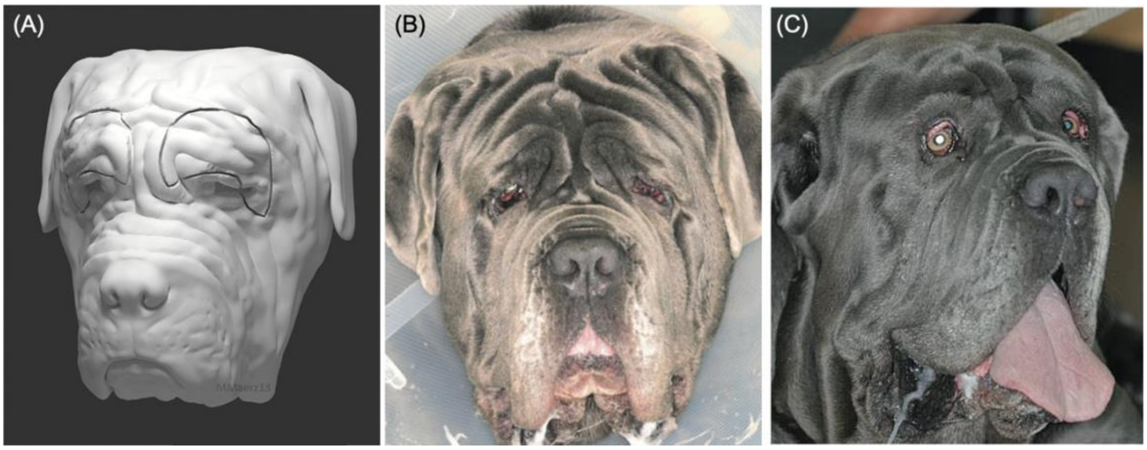


Figure 7 – (A) Schematic representation of the incision lines and the area of skin to be removed, including the lateral canthus and one-third of the eyelid superior and inferior eyelid margins. **(B)** Preoperative picture of the 3.5-year-old male Neapolitan Mastiff. Note the pseudoptosis and superior entropion due to excessive skin folds with associated inferior eyelid entropion-ectropion. **(C)** Postoperative (ten-month) picture of the same dog. (Steinmetz, 2015)

3.1.3.2 Brow sling procedures

The brow sling techniques, which consist of using a synthetic material that suspends the eyelid margin from the brow area, were first described in veterinary medicine literature by Kirschner in 1994 and later published by Willis et al. in 1999 (Cairó *et al.*, 2018).

In 2018, Cairó et al. described the outcome of a modified brow suspension technique for treating upper eyelid pseudoptosis in dogs with redundant frontal skin folds in a retrospective study of 25 cases.

The advantages of brow suspension techniques include lack of skin excision, thus reducing sutures needed and possible scars; aesthetic results more pleasant and in conformation with the breed standard if breed possesses characteristic skin folds, as in the Shar-pei or English Bulldog breed; and possible reduction of surgical time since no excision and re-suturing are required (Cairó *et al.*, 2018).

Abscess formation in 4% of the eyes, pseudoptosis under-correction in 4% of the eye, and suture rupture in 2% of the eyes (Cairó *et al.*, 2018) are reported complications associated with brow sling procedures in veterinary medicine.

3.1.3.3 Stades method

The forced secondary granulation procedure (Stades, 1987; Stades and Boeve, 1987), also known as Stades procedure, removes part of the upper eyelid skin and eyelashes and uses secondary intention wound healing to resolve the upper eyelid entropion (Cairó *et al.*, 2018).

In this technique, an incision is made along the “*gray line*” and is continued in a semicircular shape, with the widest diameter of the circle opposite the area of the greatest eyelid inversion. The skin is then removed. The dorsal margin of the surgical excision is partially undermined and is sutured to the wound bed approximately five millimeter from the lid margin. The technique relies on wound contracture to evert the lid and the formation of a smooth, hairless proximal lid margin, which will not irritate the cornea even if minor entropion is still present after surgery (Lackner, 2001).

The main advantages include reduced surgical time, minor changes in facial appearance (Cairó *et al.*, 2018), and the creation of a hairless edge. The hairless edge can be beneficial in cases where entropion is still present; this way, trichiasis will not occur because all hair follicles have been removed (Lackner, 2001). Contrariwise, disadvantages are open wound healing and the fact that excessive facial skin is not addressed, so pseudoptosis and vision impairment may persist (Cairó *et al.*, 2018).

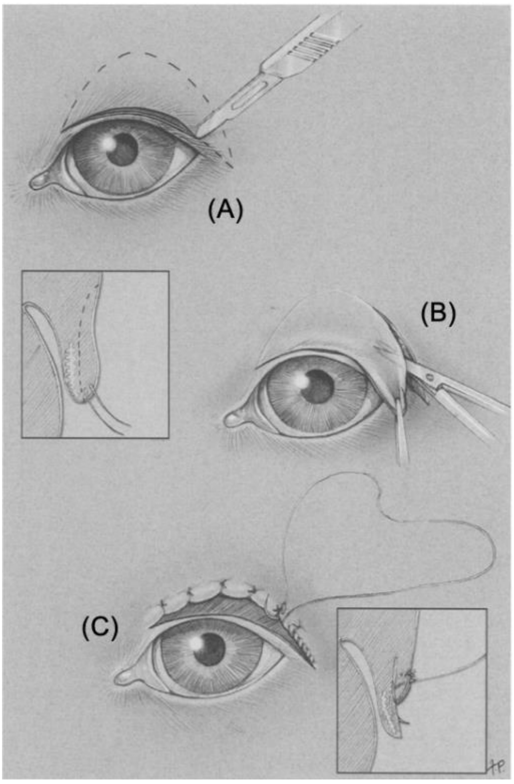


Figure 8 – Schematic representation of the forced secondary granulation procedure. (A) and (B) A semicircular shaped piece of upper eyelid skin is removed. (C) The dorsal margin of the surgical excision is partially undermined and sutured to the wound bed approximately five millimeter from the lid margin (adapted from Lackner, 2001).

3.1.3.4 Brow tacking

Brow tacking, also referred to as eyelid tacking, is a temporary procedure used to evert the eyelids mainly used in puppies, especially in the Shar-pei breed (Moore and Constantinescu, 1997; Stades and Woerdt, 2021). This eversion is achieved by placing two to four 5-0 to 6-0 nonabsorbable or absorbable tacking sutures adjacent to the involved eyelid margin (Stades and Woerdt, 2021). The needle is inserted into the skin at the base of the Meibomian glands (approximately three mm from the eyelid margin) and into the *orbicularis* muscle, directed away from the eye to exit the skin about eight-millimeter from the eyelid margin. The eyelid margin or conjunctival surface of the eyelid should not be penetrated (Moore and Constantinescu, 1997). Simple, interrupted mattress sutures or interrupted, vertical mattress sutures are placed in the lower and less frequently in the upper eyelids (Stades and Woerdt, 2021).

Sutures are removed after four to six weeks if present at that time. The surrounding scar tissue causes traction on the lid margin and, in some cases, can lead to entropion correction(Stades and Woerdt, 2021).

This procedure does not approach pseudoptosis correction, as the redundant skin folds remain.

3.1.3.5 Celsus-Hotz technique

The Celsus-Hotz procedure does not manage pseudopstosis, as it only everts the margin to its correct anatomical place, correcting entropion. In addition, the excessive skin folds' downward forces placed on the upper eyelid may negate entropion correction even if this technique is used. Therefore, surgical methods to relieve or remove these forces and subsequently resolve pseudoptosis are necessary to an effective entropion treatment (Stuhr *et al.*, 1997).

3.1.4 Considerations on eyelid surgery

3.1.4.1 Preoperative evaluation

The evaluation of the eyelids preoperatively is of paramount importance.

The presence of pain, blepharospasm and enophthalmia can influence eyelid position and their relationship with other ophthalmic structures. Factors like age, body composition, hydration status, and muscle condition can also affect lid position. These variables should be taken into consideration and must be assessed when determining a surgical plan (Gelatt and Whitley, 2011).

Secondary blepharospasm is a common concomitant finding with palpebral abnormalities. It involves a spastic contraction of the *orbicularis oculi* muscle, and it indicates pain. All causes of blepharospasm should be assessed before attempting corrective palpebral surgery. When present due to palpebral disease, it is generally because of the irritation caused by the inwards rolling of the eyelid margin and the trichiasis of the normal cilia and hair present in the palpebral area. This inner folding causes further pain and irritation, which worsens the eyelid defect and blepharospasm, creating an escalating cycle of pain and irritation (Gelatt and Whitley, 2011).

These circumstances should be considered when estimating the extent of the surgery so that over-correction is not pursued and only the anatomic abnormality is addressed. The purpose of surgery is to correct the conformational entropion, not the spastic component (Bettenay et al., 2018).

The extent of skin that will be resected should be accurately estimated before sedation, premedication, or induction. A skin marker can be used to assist in this process (Bettenay et al., 2018).

3.1.4.2 Anesthesia

Generally, the combination of sedation and local anesthesia are not enough for eyelid surgery (Stades and Woerdt, 2021). Eyelid procedures typically require induction with injectable anesthetics and continued general anesthesia with inhalational agents (Gelatt and Whitley, 2011).

3.1.4.3 Surgical field preparation

Preparation of the palpebral skin should be done immediately before surgery.

The hair should be clipped very carefully with a small electric clipper. This step should be executed gently to prevent the thin and delicate palpebral skin from getting abrasions or scratches. These injuries can generate additional irritation, inflammation, and swelling postoperatively, delaying the healing process (Gelatt and Whitley, 2011).

The most used surgical scrub preparation is 0.5% povidone-iodine solution as contact with the cornea is not irritating (Gelatt and Whitley, 2011).

3.1.4.4 Surgical instrumentation

The recommended ophthalmic instruments for eyelid surgery (Figure 9) include tenotomy scissors, teeth (1x2) delicate forceps, scalpel and scalpel blades (number 11 and number 15), small wire eyelid speculum, a Jameson caliper, and a needle holder. Special thumb forceps, such as chalazion and entropion forceps, help stabilize the eyelids during surgery. Small, curved mosquito hemostats are helpful to provide hemostasis.

For more extensive eyelid surgeries, such as rhytidectomy, extra instrumentation is needed. These include a measuring rule and a surgery pen, Adson teeth (1x2) forceps, curved Metzenbaum scissors, and a soft tissue needle holder.

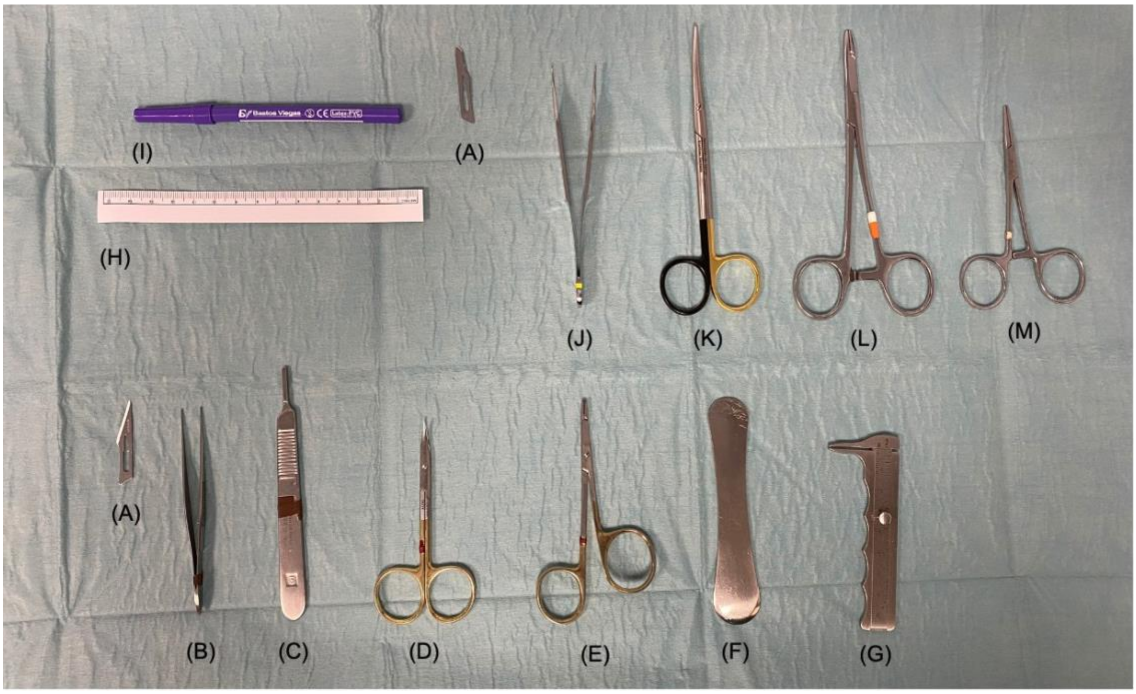


Figure 9 – Surgical instrumentation needed to perform eyelid surgery. In the lower row are present the instruments used in routine eyelid surgery. In the upper row are present instruments needed for larger blepharoplasties, such as rhytidectomies. **(A)** Scalpel blade (upper is number 15 and lower is number 11); **(B)** delicate forceps; **(C)** scalpel number 3; **(D)** Stevens tenotomy scissors; **(E)** needle holder; **(F)** eyelid plate; **(G)** Jameson caliper; **(H)** paper ruler; **(I)** marker pen; **(J)** Adson teeth (1x2) forceps; **(K)** curved Metzenbaum scissor; **(L)** soft tissue needle holder and **(M)** mosquito hemostats (courtesy of Dr. Cristina Seruca).

Although suture selection is essential, the choice is often variable and at the surgeon's discretion (Gelatt and Whitley, 2011). For example, for Dr. Cristina Seruca (DVM, Dip. ECVO, MRCVS, EBVS), sutures involving the eyelid should be between 5/0 and 6/0, while sutures implicating head skin can be between 3/0 to 4/0. For the subcutaneous layer, it should be used a monofilament absorbable suture and for the skin a monofilament non-absorbable suture, in order to reduce skin scarring. The needle should be an extra fine cutting needle with a reverse cut (Stades and Woerdt, 2021).

3.2 NOVEL COMBINED MIDLINE AND CORONAL RHYTIDECTOMY TECHNIQUE

Up until this point, a literature review was made to contextualize this monograph: the anatomy of the eyelids and their importance in a pain-free physiological vision, the meaning of pseudoptosis and its impact in the ophthalmologic system, and the current surgical therapies available to manage pseudoptosis in the dog.

The need for a new rhytidectomy technique emerges, considering none of the formerly referred techniques adequately resolve pseudoptosis, especially in breeds that do not have skin folds. The present section describes a novel rhytidectomy technique called "Combined midline and coronal rhytidectomy technique", developed by Dr. Cristina Seruca. Afterwards, five clinical cases will be presented in which the novel technique was used.

Preoperative assessment of the patient is made before sedation to re-assess all eyelid diseases present. Identification of parameters that may affect eyelid positioning, such as frontal skin laxity, size and anchoring of the ears, presence of nasal folds, and lateral canthus laxity, is also made before sedation. If the patient has long hair, a rough clip of the forehead can be helpful to rightfully assess the amount of tissue to be removed (Figure 10A). The calculation of the quantity of skin that needs to be removed is made by grasping the frontal and parietal area excess skin upward and caudally so that the eyelids move to the desired anatomic position. The one-hand movement pulls the skin from two axes: the horizontal axis, where the skin is pulled axially from the sides to the center, and a sagittal axis, where the skin is pulled in an anteroposterior direction (Figure 16B). The resulting shape is composed of the natural stress lines created by the grasp. It can be subdivided into two parts: an elliptical-shaped longitudinal area at the top of the forehead that extends from the insertion of one ear to the other; and a triangular-shaped area between the eyes, where the base of the triangle is in conjunction with the elliptical shape and the triangle apex is aligned with the medial canthi. The shape is marked with a pen as a guide to the limits of the skin the be excised.

Figure 10 - Preoperative assessment of the eyelid conformation is of paramount importance for the outcome of the surgery. **(A)** Observing the dog in a controlled and calm environment without head manipulation allows the evaluation of the true eyelid conformation. **(B)** Rough draw of the incision lines done just before entering the surgical theatre (courtesy of Dr. Cristina Seruca).

Once the patient is under general anesthesia, it is placed in a sternal recumbency position with its chin lying on a squared pillow or folded towel. Care needs to be taken so that the head is symmetrical, with both eyes parallel to the table. The final marking is made at this stage.

The entire forehead descending into the neck, palpebrae, and the under-eye area is clipped. The clipped area is vacuumed so that the excess hair is removed. After that, the skin is rinsed and aseptically prepared with povidone-iodine solution. Both corneas are rinsed with a diluted 0.5% povidone-iodine solution to flush any hair and debris, followed by the application of artificial tears (carbomer 2 mg/g) to protect both corneas against dryness during the procedure. After this process, the guideline previously made, usually become very faint. Re-application of the guideline is made once the patient is in the surgical theatre, just before the beginning of the surgery, with a sterile surgical marker. The quantity and shape of skin that needs to be excised differs in every case. The marking in this stage is more precise and warrants the use of a ruler to guarantee the symmetry in the face. The ears are also protected with a bandage at the preparation stage.

Excision of the skin in the shape previously described is performed, firstly using a scalpel and then scissors (Figure 11A and 11B). The dissection is performed at a very superficial subcutaneous plane because it is imperative to preserve big vessels and nerves. Excellent anatomic knowledge is of utmost importance when executing this technique. The surgical defect then is sutured in standard two layers manner: simple interrupted suture pattern combined with a simple continuous suture pattern in two sections in the subcutaneous tissue, using 3-0 absorbable suture, and simple interrupted suture pattern using 3-0 non-absorbable suture on the skin (Figure 11C). Further necessary eyelid surgery can be performed in both upper eyelids' lateral and central parts if needed (Figure 11D and 11E).

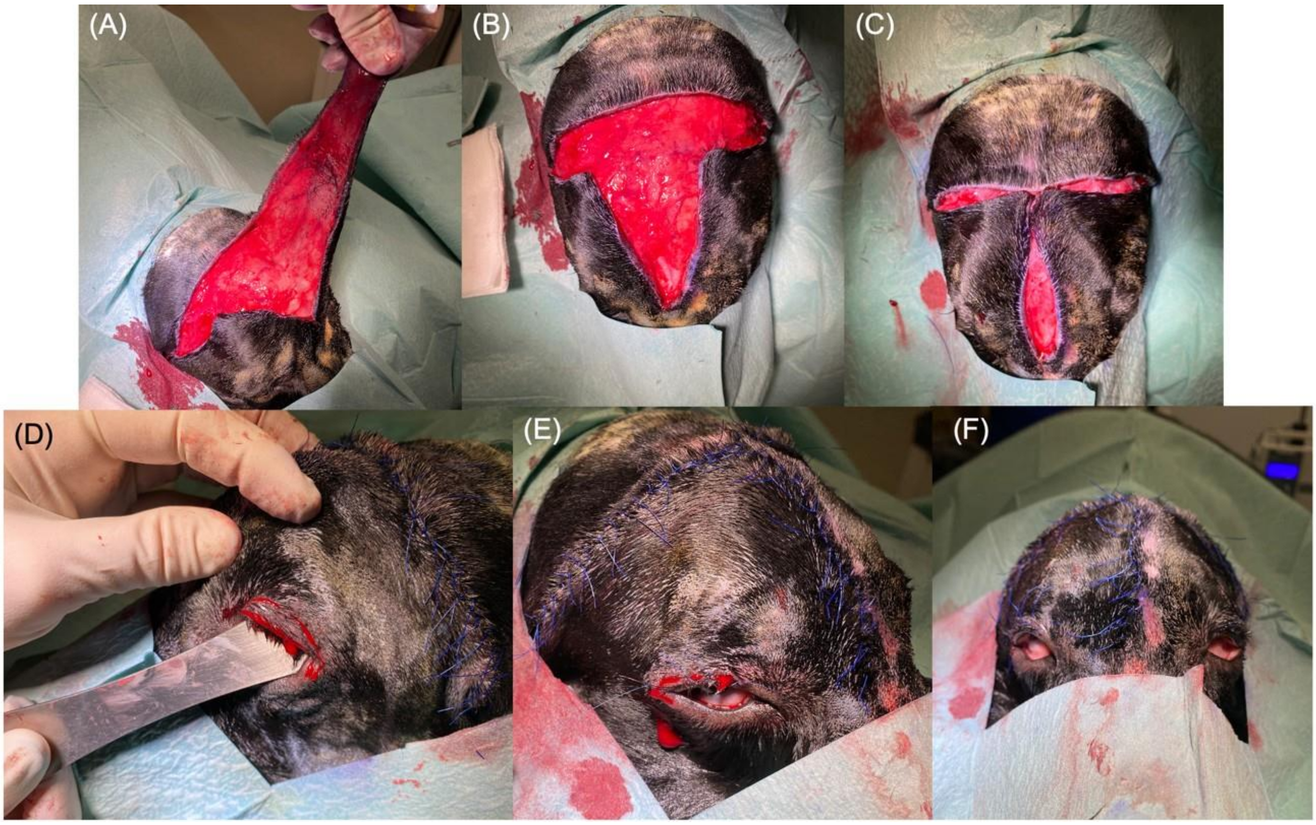


Figure 11 – (A) - (C) the combined midline and coronal rhytidectomy technique **(A)** skin removal starts firstly using a scalpel, along the lines of the shape previously drawn, and then scissors. This initial section must be done with extreme caution so not to damage any nerves, including the palpebral nerve; **(B)** result after total skin excision; **(C)** the suturing process starts at the angles with using a standard two layers manner: simple interrupted suture pattern combined with a simple continuous suture pattern in two sections in the subcutaneous tissue, using 3-0 absorbable sutures, and simple interrupted suture pattern using 3-0 non-absorbable sutures on the skin; **(D)** and **(E)** further necessary eyelid surgery can be performed in both upper eyelids' lateral and central parts if needed; **(F)** final result of the surgery (courtesy of Dr. Cristina Seruca).

3.3 CLINICAL CASES

This segment will present five clinical cases of patients diagnosed with pseudoptosis and treated with the novel combined midline and coronal rhytidectomy technique described previously.

All cases were referral cases observed in private practice in Portugal and United Kingdom between 2014 and 2020. The following data was documented from the patients' medical records: signalment (breed, gender, date of birth), main ophthalmic complaint, palpebral and corneal findings, other ophthalmic examination anomalies, ophthalmic diagnose, postoperative treatment, postoperative complications, and follow-up time.

All patients were submitted to a complete ophthalmic examination executed by European Veterinary Specialist Cristina Seruca. Ophthalmic examination included:

- acquirement of signalment and a thorough history;
- distance observation;
- neuro-ophthalmic examination, including assessment of menace response and palpebral, dazzle, and pupillary light reflexes;
- Schirmer tear test-I (STT-I) (STT-I; standardized sterile strips, Madhu Instruments, New Delhi, India), if indicated;
- examination of the eyelids, conjunctiva, nictitating membrane, lacrimal puncta, cornea, anterior chamber, and iris via slit-lamp biomicroscopy (SL-15, Kowa Optimed, Düsseldorf, Germany);

- measurement of intraocular pressure (IOP) via rebound tonometry (Tonovet, Icare, Vantaa, Finland)
- examination of the lens and vitreous also by slit-lamp biomicroscopy;
- examination of the retina and optic nerve head by indirect ophthalmoscopy (2.2 PanRetinal, Volk Optical Inc., Mentor, Ohio, USA and Spectra Iris indirect ophthalmoscope, Keeler, Windsor, United Kingdom)
- fluorescein staining (Fluorescein Sodium 1mg sterile strips, Madhu Instruments, New Delhi, India), if indicated.

All surgeries were performed by Dr. Cristina Seruca. The surgeries were performed in two different hospitals: Optivet Referrals, in Hampshire, United Kingdom and VetOeiras Veterinary Hospital, in Oeiras, Portugal.

3.3.1 Clinical case 1

Eddie, a male English cocker spaniel, born on February 6nd, 2012, was referred to VetOeiras Veterinary Hospital on January 15th, 2020, for specialist ophthalmic evaluation of eyelid abnormalities and visual impairment.

Eddie's owners reported chronic vision loss. The owners had no other complaints and stated the Eddie had no other medical history.

A complete ophthalmic examination was performed. The neuro-ophthalmic examination showed a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. A significant decrease in menace response was noted. The adnexal examination showed severe pseudoptosis and bilateral superior and lateral canthal entropion of both eyes and inferolateral entropion of the left eye. The slit-lamp examination revealed bilateral physiological appearance of the cornea, anterior chamber, and iris. The Tyndall effect was negative in both eyes. The IOP was 14 mmHg in both eyes. The funduscopic examination showed a physiological appearance of both retinas and optic nerve heads for his age. STT-I and fluorescein staining were not performed. Eddie was diagnosed with severe pseudoptosis and bilateral superior and lateral canthal entropion of both eyes and inferolateral entropion of the left eye (Figure 10A).

Surgical treatment with the novel combined midline and coronal rhytidectomy and the Celsus-Hotz technique was recommended to correct the eyelid conformation.

Eddie was submitted to eyelid surgery on January 15th, 2020. In addition to the rhytidectomy technique, Eddie was also submitted to lateral canthal arrowhead Celsus-Hotz surgical correction of both eyes, which also includes the inferolateral third of the left eye. The surgical defect was sutured with simple discontinuous sutures using a non-absorbable synthetic monofilament suture made of polyamide polymers in 6-0 in both eyes. The surgery was uneventful.

Eddie was kept in hospitalization overnight and was discharged the next day (January 16th, 2020) with an Elizabeth collar, systemic anti-inflammatory (Robenacoxib 1-2 mg/kg, one tablet *per os* (PO) every 24 hours, for six days) and systemic antibiotic (Cefalexin 15 mg/kg, one tablet PO every 12 hours, for ten days). The revaluation was recommended eight to nine days post-discharge.

Figure 12 – Clinical case 1 (Eddie) immediate post-surgery result. At this stage, post-operative oedema and inflammation are expected (courtesy of Dr. Cristina Seruca).

Eddie came for revaluation on January 27th, eleven days post-discharge (Figure 13). The owners reported that Eddie was much more playful and cheerful since the surgery and had significantly improved his visual behaviour. They also reported that both eyes were open and without signs of discomfort (blepharospasm, tearing and hyperaemia) since the surgery. On that day, the sutures were removed under mild sedation.

The neuro-ophthalmic examination showed a positive menace response and a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination revealed a correct and symmetrical eyelid conformation. The application of a bacitracin ointment, twice daily, for five days, in the suture site and the use of the Elizabeth collar for eight more days were recommended.

Figure 13 – Clinical case 1 (Eddie) eleven days post-operation. The eyelids have a correct conformation and pseudoptosis and entropion are no longer present. Post-operation oedema and inflammation are expected to be no longer present (Courtesy of Dr. Cristina Seruca).

A second follow-up was done one-month post-operation (Figure 14). All the incision lines were healed entirely, and the head hair had already grown. The ophthalmic examination showed a correct and symmetric eyelid conformation, a positive menace response, and a complete palpebral reflex. The owners were pleased with the functional and aesthetic results of the surgery.

Figure 14 – Clinical case 1 (Eddie) one-month post operation. Eyelid conformation remains correct. There is no visible scarring, and the head hair has grown completely and without any complication (courtesy of Dr. Cristina Seruca).

According to the available records, this was the last follow-up in Eddie’s case; however, the author contacted Eddie’s owner, via telephone call, on November 9th, 2021, one year and almost ten months post-surgery, to get photographic feedback of long-term results on Eddie's surgery. In the call, the owner manifested how pleased she was from the surgery results. According to the owner, Eddie presented a completely normal visual behaviour, correct eyelid conformation (confirmed by the photographs sent) and no signs of discomfort (Figure 15).

Figure 15 – Clinical case 1 (Eddie) one year and almost ten months post-surgery.

3.3.2 Clinical case 2

Bobby, a male English cocker spaniel born on June 9th, 2007, was referred to Optivet Referrals on June 22th, 2016, for specialist ophthalmic evaluation of vision loss.

The owners reported a significant reduction in Bobby's visual capacity since the last two to three years. Bobby had been diagnosed with bilateral autoimmune keratoconjunctivitis sicca (KCS) approximately three years prior and was in treatment with topical cyclosporine 0.2%, three times daily at the time of consultation. Besides the KCS, Bobby had no other medical history.

A complete ophthalmic examination was performed. STT-I was 15 and 22 mm/min in the left and right eye, respectively. The neuro-ophthalmic examination showed a significantly decreased menace response and a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination revealed severe bilateral pseudoptosis, bilateral supra-lateral entropion and severe bilateral conjunctival palpebral hyperaemia (Figure 16A). The slit-lamp examination revealed a superficial corneal ulcer in the ventrolateral quadrant of the right eye, confirmed afterwards by a positive fluoresceine staining. The Tyndall effect was negative in both eyes. The IOP measurements were within normal limits (normal range: 12-25 mmHg). The funduscopic examination showed a physiological appearance of both retinas and optic nerve heads for his age. Bobby was diagnosed with severe bilateral pseudoptosis, bilateral supra-lateral entropion, severe bilateral secondary conjunctivitis, and a superficial corneal ulcer in the right eye.

A bandage contact lens was placed on the right eye, and the application of a carbomer, three times daily, and chloramphenicol eye drops, three times daily in the right eye were recommended. Surgical treatment with the novel combined midline and coronal rhytidectomy and the Celsus-Hotz technique were recommended to correct the eyelid conformation.

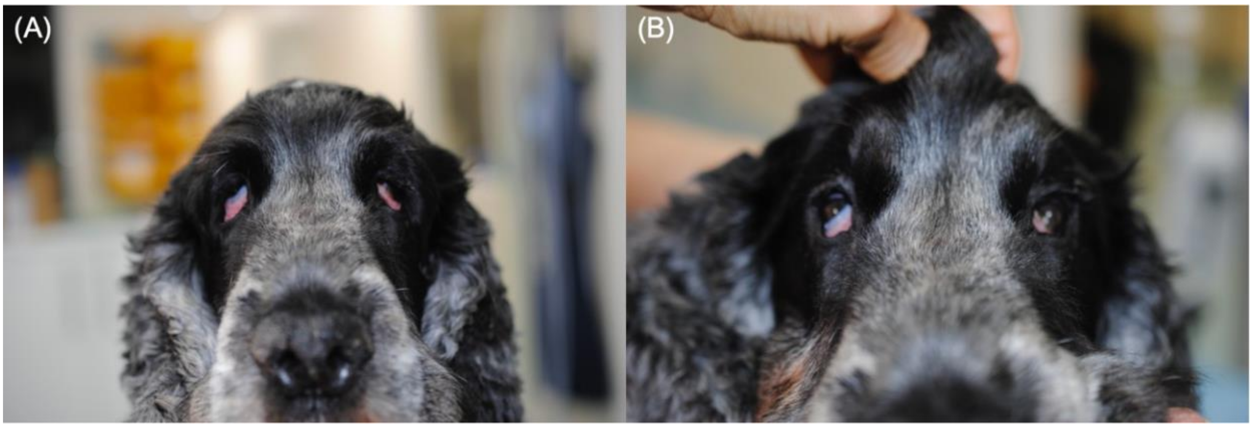


Figure 16 – Clinical case 2 (Bobby) pre-operation appearance. (A) Notice the almost complete blockage of the visual axis by the present pseudoptosis and the severe inferior conjunctival exposure. (B) The one-hand movement represented here pulls the skin medially and caudally (courtesy of Dr. Cristina Seruca).

Bobby was submitted to eyelid surgery on July 7th, 2016. In addition to the rhytidectomy technique, Bobby was also submitted to superior and lateral canthal Celsus-Hotz technique in both eyes. The Celsus-Hotz technique was sutured with simple discontinuous sutures using a non-absorbable synthetic monofilament suture in 6-0 in both eyes. The surgery occurred without any complications.

Bobby was kept in hospitalization overnight and was discharged the next day (July 8th, 2016) with an Elizabeth collar, systemic anti-inflammatory (Meloxicam, 0.1 mg/kg, PO, every 24 hours, for eight days) and systemic antibiotic (Cefalexin 15 mg/kg, one tablet PO every 12 hours, for ten days) and carbomer four times daily in both eyes. The revaluation was recommended two weeks post-discharge.

Bobby came for revaluation on July 18th, ten days post-discharge (Figure 17). The owners reported that Bobby had significantly improved his visual behaviour and that he had no signs of discomfort (blepharospasm, tearing and hyperaemia) since the surgery. On that day, the sutures were removed.

The neuro-ophthalmic examination showed a positive menace response and positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination revealed a correct and symmetrical eyelid conformation. Negative fluorescein staining revealed a complete healing of the superficial corneal ulcer detected on the first consultation.

Figure 17 – Clinical case 2 (Bobby) ten days post-operation. Correct eyelid conformation is present. Bobby has the left nictitate membrane pigmented while the right one is not. This difference can give the false impression of asymmetry to the owners, even though the eyelids are perfectly symmetrical (Courtesy of Dr. Cristina Seruca).

3.3.3 Clinical case 3

Beau, a male Clumber spaniel born on September 5th, 2002, was referred to Optivet Referrals on September 26th, 2014, for specialist ophthalmic evaluation of eyelid abnormalities and visual impairment.

The owners reported a chronic reduction in Beau's visual capacity and bilateral redness and ocular discharge. He had history of bilateral keratoconjunctivitis sicca and was being treated with cyclosporine 0.2%, one application twice daily in both eyes, and with a corticosteroid and antibiotic ointment combination (dexamethasone, polymyxin B sulphate, and neomycin sulphate) one application twice daily on both eyes at the time of consultation. According to the owners, Beau showed partially improvement with the treatment; however, he continued to have bilateral purulent discharge and no significant difference was noted after beginning treatment with the corticosteroid and antibiotic ointment combination.

A complete ophthalmic examination was performed. STT-I was 1 and 5 mm/min, in the right and left eye, respectively. The neuro-ophthalmic examination showed a positive dazzle, palpebral reflexes. A significantly decreased in menace response and negative pupillary light (both direct and indirect) reflexes (due to severe bilateral iris sphincter atrophy) in both eyes was noted. The adnexal examination showed a diamond-shaped eyelid conformation, severe macroblepharon, severe pseudoptosis, severe upper entropion, lower ectropion, severe conjunctival palpebral hyperaemia and mucopurulent discharge (Figure 18) of both eyes. The slit-lamp examination revealed mild dorsolateral fibrosis and oedema of the right cornea and moderate diffuse corneal oedema, fibrosis and superficial corneal neovascularization of the left eye. Both eyes presented severe iris sphincter atrophy and lens sclerosis. The Tyndall effect was negative in both eyes. The intraocular pressure was 9 and 6 mmHg in the right and left eye, respectively. The funduscopic examination showed a physiological appearance of both retinas and optic nerve heads for his age. Beau was diagnosed with diamond-shaped eyelid conformation, macroblepharon, severe pseudoptosis, severe upper entropion, lower ectropion, severe KCS, iris atrophy and lens sclerosis of both eyes.

A treatment with tacrolimus 0.03% eye drops, one drop three times daily to both eyes, acid fusidic eye gel, one application, once daily to both eyes and carbomer, one application six times daily to both eyes, was recommended. Surgical treatment with the novel combined midline and coronal rhytidectomy and lateral canthoplasty was recommended to correct the eyelid conformation.

On consultation, a singular mass with five centimeter of diameter, with a soft consistency was noted in the middle on the frontal area. A FNA cytology was performed at the consultation. The sample was sent to a laboratory for analysis. A week later the result came consistent with lipoma.

Beau was submitted to surgery on October 30th, 2014. In addition to the rhytiectomy technique, a lateral canthoplasty was performed in both eyes (six- and five-mm length were removed from the lower and upper lid, respectively). The canthoplasty defect was suture in two plans (simple continuous suture on the subconjunctival tissue using an absorbable synthetic monofilament suture in 6-0; a figure 8 suture on the lid margin and simple interrupted sutures on the skin using a non-absorbable synthetic monofilament suture in 5-0. The lipoma was completely removed, since it was situated in the skin area that needed to be removed, and was sent for histopathologic examination, for a definitive diagnosis. The surgery occurred without any complications.

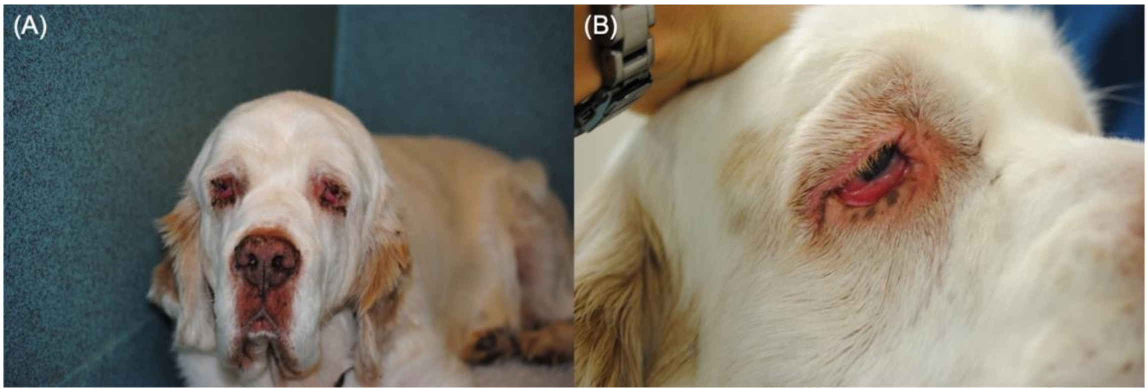


Figure 18 – Clinical case 3 (Beau) pre-operative appearance. **(A)** Note the diamond-shaped eyelid conformation, macroblepharon, severe pseudoptosis, severe upper entropion, lower ectropion, severe palpebral conjunctival hyperaemia, and mucopurulent discharge present. The visual axis is almost completely obstructed by the pseudoptosis present. **(B)** Close-up of the eyelid conformation (in this picture, the mucopurulent discharge had already been removed) (courtesy of Dr. Cristina Seruca).

He was discharged the same day with an Elizabeth collar, systemic anti-inflammatory (Meloxicam, 0.1 mg/kg, PO, every 24 hours, for eight days), systemic antibiotic (Cefalexin 15 mg/kg, one tablet PO every 12 hours, for fifteen days), chloramphenicol eye drops, one drop three times daily to both eyes and tacrolimus 0.03% eye drops, one drop four times daily to both eyes. The revaluation was recommended two weeks post-discharge.

Beau came for revaluation on November 10th, 2014, two weeks post-discharge. According to the owners, he was feeling much better, had significantly improved his visual behaviour, showing a more alert behaviour since the surgery. On that day, the sutures were removed. Histopathologic examination of the frontal mass was diagnostic of lipoma (with complete resection). STT-I was 20 and 15 mm/min in the right and left eye, respectively, which showed a significant improvement in tear production. The neuro-ophthalmic examination showed a positive menace response and dazzle, palpebral reflexes. The adnexal examination showed complete resolution of entropion, macroblepharon, ectropion and pseudoptosis (Figure 19C and 19D). The slit-lamp examination revealed that both corneas were much more transparent, with a significantly reduced corneal oedema and neovascularization.

The following medical treatment was recommended to be continued: tacrolimus 0.03% eye drops, one drop four times daily to both eyes and systemic antibiotic cefalexin 15 mg/kg, one tablet PO every 12 hours, until the completion of 15 days of treatment).

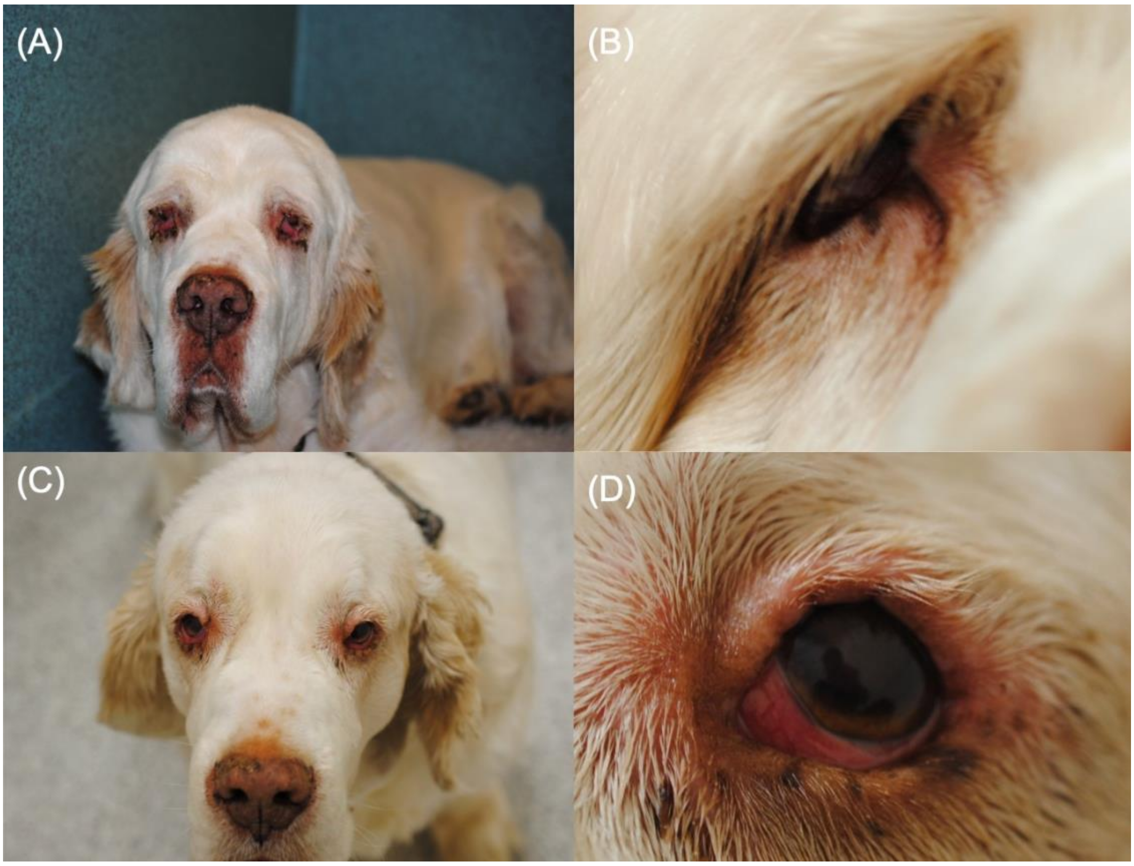


Figure 19 – Comparison between pre-operation **(A)-(B)** and one-month post-operation appearance **(C)-(D)**, in clinical case 3 (Beau). Note in **(C)** and **(D)** the correct eyelid conformation and unobstructed visual axis. (Courtesy of Dr. Cristina Seruca)

The two next revaluations were six weeks and two and a half months after surgery, where correct eyelid conformation and function were confirmed, as well as the resolution of the conjunctival clinical signs. Beau's last follow-up was on December 17th, 2015, one year and almost three months after surgery. At revaluation, Beau presented a correct eyelid conformation, an unobstructed visual axis and a normal tear production (normal range: 15-25 mm/min). Beau's owners were really pleased with the outcome of the surgery.

3.3.4 Clinical case 4

Vigo, a male Basset mix born on January 7th, 2014, was referred to Optivet Referrals on March 12th, 2015, for specialist ophthalmic evaluation of eyelid abnormalities and visual impairment.

The owners reported a significant reduction in Vigo's visual capacity since the last two years. Vigo had been previously submitted to corrective eyelid surgery using a modification of the Kuhnt-Szymanowski technique, to correct bilateral lower entropion, in January 2015. According to the owners, despite the surgery, Vigo still had signs of ocular discomfort.

A complete ophthalmic examination was performed. The neuro-ophthalmic examination showed a significantly decreased menace response and a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes in both eyes. The adnexal examination revealed severe bilateral pseudoptosis, mild lower macroblepharon and mild bilateral infra-lateral entropion. The slit-lamp examination revealed a physiological appearance of the cornea, anterior chamber, and iris of both eyes. The Tyndall effect was negative in both eyes. The IOP measurements were within normal limits (normal range: 12-25 mmHg). The funduscopic examination showed a physiological appearance of both retinas and optic nerve heads for his age. STT-I and fluorescein staining were not performed. Vigo was diagnosed with severe bilateral pseudoptosis, mild lower macroblepharon and mild bilateral infra-lateral entropion.

Surgical treatment with the novel combined midline and coronal rhytidectomy and the Celsus-Hotz technique was recommended to correct the eyelid conformation.

Vigo was submitted to surgery on April 8th, 2015. In addition to the rhytidectomy technique, a modified infra-lateral Celsus-Hotz procedure was performed in both eyes. The lower eyelid length was shortened four millimeter through a V-wedge resection and the defect was suture in two layers (subcutaneous tissue with a simple continuous suture using an absorbable synthetic monofilament suture in 6-0, a figure-eight suture pattern in the eyelid margin and simple interrupted sutures on skin using a non-absorbable synthetic monofilament suture in 5-0. A modified Celsus-Hotz procedure was performed in the lateral part of both lower eyelids. The surgical defect was sutured with simple interrupted sutures using a non-absorbable synthetic monofilament suture in 5-0. The surgery occurred without any complications.

He was discharged the same day with an Elizabeth collar, systemic anti-inflammatory (Meloxicam, 0.1mg/kg, PO every 24 hours, for six days), systemic antibiotic (Cefalexin 15 mg/kg, one tablet PO every 12 hours, for ten days), and acid fusidic eye gel, one application twice daily to both eyes for ten days. The revaluation was recommended two weeks post-discharge.

Vigo came for revaluation on April 21st, 2015, two weeks post-discharge. According to the owners, Vigo had significantly improved his visual behaviour and showing a much more playful demeanor since the surgery. On that day, the sutures were removed. The neuro-ophthalmic examination showed a positive menace response and a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination revealed a correct eyelid conformation and an unobstructed visual axis.

The next revaluations were performed by the referent veterinarian.

3.3.5 Clinical case 5

Hugo, a male Clumber spaniel born on January 1st, 2006, was referred to Optivet Referrals on May 12th, 2014, for specialist ophthalmic evaluation of eyelid abnormalities, visual impairment and assessment of ongoing KCS.

The owners reported a chronic significant reduction in Hugo's visual capacity. He was being treated with topical cyclosporine 0.2% at the time of consultation and, according to the owners, he had not been improving significantly with the treatment. Besides the ophthalmologic complaints, Hugo had a history of allergic dermatitis and hip dysplasia. He also, at time of consultation, recently had otitis externa that was under control. He was on treatment with gabapentin, one tablet, twice daily, PO and a tapered dose of prednisolone 5 mg every 48h for one week.

A complete ophthalmic examination was performed. The STT-I was 6 and 8 mm/min in the right and left eye, respectively. The neuro-ophthalmic examination showed a diminished menace response and a positive dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination revealed macroblepharon, severe pseudoptosis, inferior ectropion, mucopurulent discharge, moderate to severe conjunctival palpebral hyperaemia of both eyes. The slit-lamp examination showed bilateral diffuse mild corneal oedema, superficial corneal neovascularization and mild iris sphincter atrophy. The Tyndall effect was negative in both eyes. The intraocular pressure was 14 and 13 mmHg in the right and left eye, respectively. The funduscopic examination showed a physiological appearance of both retinas and optic nerves heads. The fluorescein test was negative in both eyes. Hugo was diagnosed with bilateral macroblepharon, sever pseudoptosis, inferior ectropion, secondary conjunctivitis, KCS and iris sphincter atrophy.

Treatment with cyclosporine 0.2%, one application three times a day in both eyes, chloramphenicol eye drops, one drop three times a day in both eyes for ten days and carbomer, one application four to six times daily to both eyes, was recommended. Surgical treatment with the novel combined midline and coronal rhytidectomy and lateral canthoplasty was recommended to correct the eyelid conformation.

Hugo was submitted to surgery using the combined midline and coronal rhytidectomy on August 13th, 2014. In addition to the rhytidectomy technique, a lateral canthoplasty was also performed in both eyes (eight and six mm were removed from the lower and upper lids, respectively). The defect was sutured in 2 plans (simple continuous suture in the subconjunctival tissue with an absorbable synthetic monofilament suture in 6-0; a figure of 8 suture on the eyelid margin and simple interrupted sutures in the skin using a non-absorbable synthetic monofilament suture in 5-0. The surgery occurred without any complications.

He was discharged the same day with an Elizabeth collar, systemic anti-inflammatory (meloxicam 0.1 mg/kg, PO every 24 hours, for five days), systemic antibiotic (cefalexin 15 mg/kg, one tablet PO every 12 hours, for twelve days), tacrolimus 0.03% eye drops, one application three times daily to both eyes, acid fusidic eye gel, one application, twice daily to both eyes for ten days and carbomer, one application six times daily to both eyes. The reevaluation was recommended two weeks post-discharge.

Hugo came for revaluation on September 23rd, 2014, little over one-month post-discharge. According to the owner, he was feeling much better after the eyelid surgery: both eyes had been clear of ocular discharge, the corneas were much more transparent, and his vision had increased significantly. On that day, the sutures were removed. The Schirmer tear test was 8 and 15 mm/min in the right and left eye, respectively. The neuro-ophthalmic examination showed a positive menace response and dazzle, palpebral and pupillary light (both direct and indirect) reflexes. The adnexal examination showed a correct eyelid conformation and mild to moderate conjunctival hyperaemia in both eyes. The slit-lamp examination showed a significant improvement in corneal transparency and lubrication, revealing mild diffuse corneal oedema and mild superficial diffuse corneal neovascularization in both eyes. The Tyndall was negative in both eyes. The intraocular pressure was 11 and 8 mmHg in the right and left eye, respectively. The funduscopic examination showed a physiological appearance of both retinas and optic nerves heads.

The following medical treatment was recommended to be continued: tacrolimus 0.03% eye drops, one drop three times daily to both eyes and carbomer, one application six times daily to both eyes.

The next revaluations were performed by the referent veterinarian.

3.4 DISCUSSION

Pseudoptosis, caused by excessive skin, skin folds and skin laxity, can lead to corneal and conjunctival disease and vision impairment. Different techniques have been described in veterinary medicine literature to manage pseudoptosis, including the forced secondary granulation procedure (Stades, 1987; Stades and Boeve, 1987), brow sling methods (Cairó *et al.*, 2018; Kirschner, 1994; Willis *et al.*, 1999) and varied rhytidectomy techniques (Bedford, 1990; Blogg, 1980; Kasa and Kasa, 1979; Mccallum and Welser, 2004; Steinmetz, 2015; Stuhr *et al.*, 1997).

One of the owners' main apprehensions when discussing surgical management of pseudoptosis is the conservation, or lack thereof, of the specific facial features characteristic of the breed when submitted to facial surgery, primarily when it encompasses the eyelids and periocular area. In light of this, the dog breed is one of the most crucial factors to consider when evaluating and choosing the surgical technique to manage pseudoptosis. The most advantageous method re-establishes correct eyelid conformation without drastically changing the dog's facial appearance. In breeds with characteristic excessive facial folds, such as the Shar-pei breed, brow suspension techniques are preferred since these procedures can "simulate" the distinctive facial folds by anchoring sutures to the periosteum of the frontal bone (Cairó *et al.*, 2018). An alternative described for managing pseudoptosis in Shar-peis is the stellated rhytidectomy (Stuhr *et al.*, 1997), which was described as a single case-report.

In contrast, in breeds where pseudoptosis is caused by brow droop and ear weight and position and do not sport facial folds, such as the English Cocker Spaniel and Basset hound, rhytidectomy techniques are preferred since the rugged aesthetic is not desirable.

The Stades method is also an alternative described in the management of pseudoptosis in dogs (Lackner, 2001; Stades and Woerdt, 2021; Woerdt, van der, 2004). The Stades forced granulation procedure does not manage pseudoptosis; this method only approaches the treatment of entropion, which is usually seen in association with pseudoptosis. By not addressing the problem, it does not resolve one of the main ophthalmic complaints of pseudoptosis, which is vision impairment due to an obstructed visual axis; the visual axis is still obstructed by the heavy weight caused by excessive skin. The Stades procedure also has the disadvantage of the presence of an open wound in the first weeks after surgery (Woerdt, van der, 2004). By leaving healing by second intention and formation of granulation tissue, the aesthetic outcome is unreliable with the possibility of severe scarring.

Even though the first rhytidectomy technique was introduced in veterinary medicine more than 30 years ago(Blogg, 1980; Cairó *et al.*, 2018), the technique has not been broadly reported since, with only four case reports published (Bedford, 1990; Mccallum and Welser, 2004; Steinmetz, 2015; Stuhr *et al.*, 1997) and no peer-reviewed studies describing the procedure's outcome with multiple cases have been made. This may be attributed to the fact that pseudoptosis is, to a certain extent, an individual problem and to describe a technique that works in every case is extremely difficult, if not impossible. Furthermore, pseudoptosis is often viewed as a "breed characteristic", and owners, most times, choose not to proceed with the surgery so that the appearance of the dog does not change; additionally, the rhytidectomy technique is a challenging and technical surgery to do and, finally, because it is hard to objectively measure the success of the outcome of the surgery, besides the subjective opinion of the veterinarian and the owner.

The present monograph describes the combined midline and coronal rhytidectomy technique and demonstrates its utility in the surgical management of pseudoptosis due to excessive skin and skin laxity in breeds that do not display facial folds.

The combination of excessive skin and heavy ears pull down the skin in a radial fashion as opposed to in only one direction. Current treatment options like the coronal or medial rhytidectomy only deal with forces that radiate in one direction. The strength of the novel combined midline and coronal rhytidectomy technique is that addresses the forces that pull the skin in the horizontal and sagittal axis. This is achieved by the excision of an elliptical-triangular-shaped piece of skin, that allows the skin to be lifted in an anteroposterior and lateromedial direction. The rhytidectomy technique proposed by Bedford does not pull the skin caudally and it only deals with the lateral forces, due to the elliptical-shaped vertical skin excision. Likewise, the rhytidectomy technique proposed by McCallum carries the same problem: it only addressed forces coming from one direction. It does not address lateral forces, as it only pulls the skin caudally due to the elliptical-shaped horizontal excision of the skin. Specially in the Bloodhound breed, where the heavy ears are one of the main factors in the formation of pseudoptosis, the forces radiating in this plane should be addressed. Plus, the introduction of tacking sutures makes the technique more evasive and with the additional complication such of suture dehiscence. The Steinmetz rhytidectomy tries to resolve pseudoptosis and other eyelid abnormalities in only one procedure. The case report where the technique is described presents a dog with severe cicatricial ectropion as a result of the procedure, which is not desirable.

In all five cases presented, additional surgery was done to complement the rhytidectomy in order to resolve the eyelid conformational abnormalities encountered; this included inferior Celsus-Holtz, arrowhead Celsus–Hotz and lateral canthoplasty. Pseudoptosis is usually seen combined with other eyelid abnormalities, such as superior and inferior entropion, lower ectropion and macroblepharon. While the rhytidectomy technique can help to resolve other eyelids abnormalities when pseudoptosis is corrected, additional corrective procedures must be performed to assure the best outcome for the patient.

Although post-operative favourable outcome of the surgery is warranted and extremely important, long-term success is critical in order to determine if the rhytidectomy technique is indicate for the management of pseudoptosis. The longest follow-up time in the five cases presented was one year and almost ten months after surgery, by telephonic contact with the owner and photograph observation, where a correct eyelid conformation and no relapse was noted. In the other four cases the follow-up time varied between ten days to two and a half months. This may be due to the fact that the owner feel like there is no longer need of revaluation when the sutures are removed, the incision lines are completely healed, and the eyelid conformation is correct. There is no record of new surgical intervention on the five cases presented.

Extensive surgery and anaesthetic time, removal of a large portion of skin, possible significant scaring and infection at suture sites, undesirable aesthetic results are some disadvantages of rhytidectomy procedures.

Complications such as wound stretching (Bedford, 1990), permanent scarring at the incision site (Bedford, 1990), joining of different hair colours and textures at the incision line (Mccallum and Welser, 2004), and superior cicatricial entropion (Steinmetz, 2015) have been described. In the five clinical cases described in this monograph, no complications were encountered, previously described or other.

In the authors' opinion, peer-reviewed studies need to be conducted to assess the success of the rhytidectomy technique more objectively in the management of pseudoptosis due to excessive skin in veterinary medicine by introducing fair means to measure the procedure's success and by evaluating the long-term outcome of the surgeries.

3.5 CONCLUSION

Based on the outcome of the clinical cases shown on the present monograph, the combined midline and coronal rhytidectomy technique is a surgical procedure to be considered when managing pseudoptosis, especially in dogs with excessive forehead skin, skin laxity, and heavy ears, as in the English Cocker Spaniel, Clumber Spaniel and similar breeds.

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