

**Título: Causes and
predisposing factors of
enucleation in dogs and
cats: A study of 25 cases.**

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Summary:

Enucleation is a surgical technique frequently performed in veterinary medicine. In this project, a retrospective study of the causes and predisposing factors that lead to the performance of this surgery as a treatment was carried out.

Introduction:

Ophthalmology is a branch of veterinary medicine that deals with the study of eye pathologies covering the diagnosis and treatment of these.

The history of veterinary ophthalmology is not very long, since it began to be studied in depth a century and a half ago, generally in Europe, where the first veterinary schools were established, standing out among the latter those located in France, Germany and the United Kingdom.¹

This specialty, despite not being so well known, has been a fundamental pillar in the progress of ophthalmologic treatments in both veterinary and human medicine, since the research carried out in animals has contributed to the development of therapies in humans. Therefore, the more research advances in the field of ophthalmology, the more the quality of life of patients is enhanced.¹

Specific techniques and technology have revolutionized veterinary practice, such as the introduction of the portable biomicroscope or non-invasive diagnostic imaging techniques. Likewise, within the medical and surgical field, cataract surgery and the use of laser technology in the treatment of glaucoma, intraocular neoplasms and retinal detachment have been significant.^{1,2}

Today, research lines continue to be active to find effective treatments for ocular pathologies.



Despite the progress in the area of ophthalmology, both veterinary and human, many ocular pathologies do not respond to the medical treatments prescribed in daily clinical practice, making it necessary to resort to surgical interventions, as in the case of glaucoma.

Enucleation is one of the surgical techniques used in veterinary medicine that consists of removing the eyeball and a portion of the optic nerve. This technique is usually accompanied by ablation of the palpebral margins, the lacrimal gland, the nictitating membrane, and the conjunctival epithelium.²

Enucleation has been recommended for various causes including:

- Severe ocular trauma associated with laceration and loss of ocular contents.
- Extensive intraocular neoplasia
- Presence of pain in the eyeball with impossibility of treatment, generally associated with non-visual glaucoma.
- Intractable panophthalmitis or endophthalmitis.²
- Infectious diseases affecting the eye and lacking effective treatment.
- Nonvisual, microphthalmic or phtisic eyeballs prone to chronic ocular inflammation.²
- Inability on the part of the animal's owner to provide lasting treatment that resolves the primary cause.³

There are 2 techniques for approaching enucleation in veterinary ophthalmology. The technique used is chosen according to the factors that compel enucleation and according to the surgeon.

The most commonly used surgical technique is by subconjunctival access, which includes removal of the globe, nictitating membrane, and lid margins. A lateral canthotomy is performed to facilitate exposure of the globe and insertion of the lid retractor. The bulbar conjunctiva is then incised approximately 5 mm posterior to the limbus. The conjunctiva and Tenon's capsule are separated from the globe, and the extraocularis and retractor



muscles are brought into view and sectioned at their scleral insertion. Medial rotation of the globe exposes the optic nerve. This will be grasped with curved hemostatic forceps and sectioned approximately 5 mm posterior to the globe.

Once the eyeball is removed, light pressure is exerted on the orbit with gauze sponges to control a possible diffuse hemorrhage. Nictitating membrane is then grasped with forceps and the gland of the third eyelid is removed at its base. The lacrimal gland is usually not removed, but 3 to 5 mm of the eyelid margin is removed with scissors. After that, the Tenon's capsule and conjunctiva are sutured with 4-0 absorbable suture material in a continuous pattern. Finally, the eyelids are closed with simple interrupted sutures using 4-0 monofilament nonabsorbable suture material.^{3,4}

Another technique used in enucleation is performed by transpalpebral access. In this technique the eyelids are sutured together in a continuous suture pattern, although they can also be held together with Allis forceps. This technique hinders communication between the ocular surface and the orbital contents and also removes all conjunctival tissues. Two elliptical incisions of approximately 5 mm are made behind the eyelid margins and joined near the medial and lateral corners. A deep dissection is performed that will allow identification of the bulbar conjunctiva. In addition, forward traction of the eyelids will assist with dissection of the conjunctiva until the sclera is at the limbus. Subsequent dissection and removal of the globe follows the same procedure as for the subconjunctival approach.^{3,4}

In addition to enucleation, there are other surgical techniques used for removal of the eyeball, such as exenteration and evisceration.

Exenteration is a surgical technique whose objective is to remove the eyeball, the lacrimal gland, the third eyelid and the soft tissues of the orbit. Its application is indicated for the treatment of extensive intraocular or orbital neoplasms and in cases of infection where medical treatment is not effective. The surgical technique bears some similarity to enucleation, but in this case, the dissection is outside the extraocular muscles. However, it is a more complex technique than enucleation, where complications are greater.⁴





On the other hand, evisceration is the removal of the intraocular contents, as well as the uvea, retina, vitreous humor, and crystalline lens, keeping the cornea and sclera, the fibrous tunic of the eyeball, intact.³ This technique is indicated to treat chronic glaucomas whose medical treatment is not effective and allows the placement of an intraocular prosthesis in some cases.²

Finally, it is worth mentioning orbitotomy. This is an exploratory technique indicated to evaluate and biopsy space-occupying lesions. There are several approaches to the orbit and the choice will depend on the location of the lesion.⁴

Removal of localized orbital neoplasms usually requires a more substantial approach. A transconjunctival approach allows access to lesions anterior to the equator of the eyeball. A dorsal, nasal, or temporal approach is also an option. If it is necessary to access the deep orbit, such as the zygomatic salivary gland, a porti gomatic arch can be removed with a rongeur.⁴

Complications of orbitotomies include inflammation, hemorrhages, and transient infection of the glottis, enophthalmos and strabismus.⁴

Regarding the complications that enucleation can have as a surgical technique, the following are highlighted:

- Infection after surgery, usually treated with antibiotherapy.
- The reduction of serum or blood drainage through the nasolacrimal duct to the nostrils is one of the complications described, but it is usually self-limiting.
- Sagging of the skin overlying the orbit.
- Hemorrhage after surgery usually originates from the ophthalmic vessels or the angular vein of the eye but is prevented by performing optimal ligation.
- Orbital emphysema can occur due to aspiration of air through the nasolacrimal duct and ligation of the lacrimal sac is recommended for its treatment.
- Chronic fistula and drainage due to retention of glandular tissue.⁴



- Periorbital swelling is another frequent post-surgical complication. This is treated with non-steroidal anti-inflammatory drugs once a day for 3 days.

Enucleation is a technique that hardly involves risks and whose purpose is to improve the quality of life of the animals, solving all those pathologies that medical treatment is not able to solve.

The aim of this study is to perform a retrospective review of the cases attended at the Veterinary Clinical Hospital of the University of Las Palmas de Gran Canaria in the ophthalmology service during 2022 and March 2024, in order to determine the most frequent causes of this surgical technique, as well as the factors that most predispose patients to require this surgery. To this end, an analysis of the results of the data collected will be carried out, as well as an update and discussion of the literature review.

Materials and methods:

In this study, a retrospective search of the clinical cases attended by the ophthalmology service at the Veterinary Clinical Hospital of the University of Las Palmas de Gran Canaria from the year 2022 and March 2024 was performed.

Statistical data collection:

For this, it was necessary to use GestorVet, an online veterinary center management software where the information of all patients is collected, as well as their clinical cases.

From 2022 to March 2024 a total of 382 animals were attended by the ophthalmology service of the Veterinary Clinical Hospital of the University of Las Palmas de Gran Canaria.

In order to obtain statistical data, we had a total of 25 animals where 20 of them were of the canine species (80%) and 5 were of the feline species (20%). Data collection was carried out for several parameters that would later be studied in the present work to





determine the predominant cause for the choice of enucleation as treatment, as well as the possible factors that predispose to the need to resort to this surgery. These included:

- Surgical technique used
- Species
- Breed
- Sex
- Age
- Reproductive status
- Cause of enucleation
- Enucleated eye
- Comparison of non-enucleated eye
- Post-surgical complications
- Anatomical Pathology

From the data collected, a percentage associated with each variable was obtained, in order to be able to conclude, according to the statistical analysis, the incidence of enucleation in the aforementioned veterinary clinical hospital, relating it to the most frequent causes and all those variables that apparently predispose to this procedure.

Inclusion and exclusion criteria

- Inclusion: All those animals of the canine and feline species that underwent enucleation at the HCV ULPGC between 2022 and March 2024 were included in the study.
- Exclusion: We excluded from the study all those animals that were not of the canine and feline breed (ruminants, equids, lagomorphs...), as well as those that, even having undergone enucleation and appearing in GestorVet, had not undergone surgery at the HCV ULPGC.





Bibliographic review

To compare the data obtained, an exhaustive bibliographic search was made of the information available in various databases such as PubMed, Scielo and Mendeley, as well as reference books on the specialty, including the book Veterinary ophthalmology, by Kirk N. Gelatt or Fundamentals of Veterinary Ophthalmology by D. Slatter. In addition, the international journal of veterinary ophthalmology, Veterinary Ophthalmology, Veterinary record was consulted.

Results

A total of 382 animals were attended by the ophthalmology service at the HCV ULPGC, with a total of 320 dogs, which is the 83.77%, and 62 cats, which is the 16.23% of the total number of animals attended.

DOGS AND CATS TREATED BY THE OPHTHALMOLOGY SERVICE

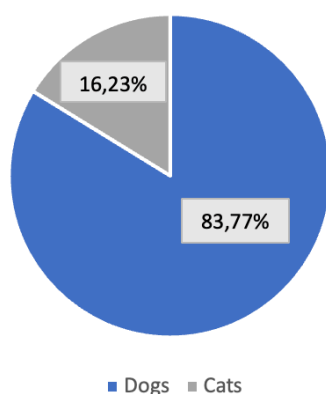


Figure 1: Number of animals attended by the ophthalmology service.

Of the 382 cases seen in the ophthalmology service, 25 of them were diagnosed and treated with the surgical technique of enucleation in the Veterinary Clinical Hospital of the ULPGC during the years 2021 and 2024. To obtain the results, a series of parameters were collected, among which we found: species, breed, sex, age, reproductive status, cause of enucleation, enucleated eye, as well as comparison of the healthy eye, post-surgical complications, and the performance of biopsy for specific diagnosis.



- Species:

Of the 25 cases registered in the ophthalmology service, it was observed that the percentage of dogs that had undergone enucleation was considerably higher than the number of cats undergoing the same surgery. Of the 25 animals, 20 of them were of the canine species, representing 80% of the cases compared to 5 animals of the feline species, representing 20%.

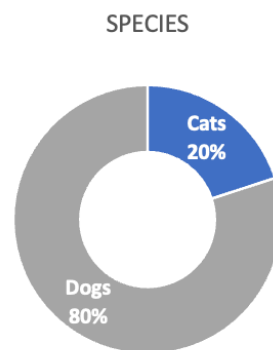


Figure 2: Incidence of enucleation in dogs and cats.

- Breed:

First of all, a manifest variety was observed among the breeds of canids that underwent enucleation. Most of the dogs were Chihuahuas, with 8 patients of this breed, representing 40% of the total number of canine patients seen (20). Mongrel dogs were second on the list, with 5 individuals, accounting for 25% of the total. This was followed by an American pit bull terrier (5%), a German shepherd (5%), a Yorkshire terrier (5%), an English bulldog (5%), a Shih Tzu (5%), a French bulldog (5%) and a Dachshund (5%).



BREEDS

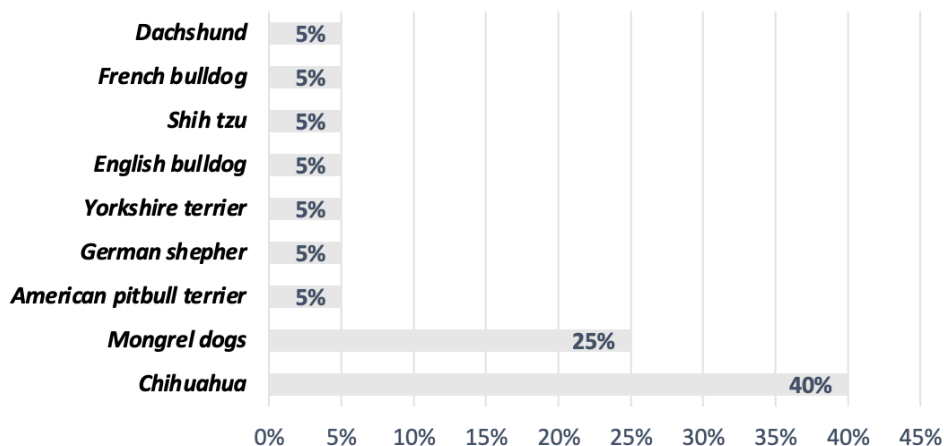


Figure 3: Incidence of canine breeds subjected to enucleation.

Secondly, and about the feline species, a higher incidence was observed in the common European breed, with 4 of the 5 cats subjected to enucleation, accounting for 80% of the individuals of the feline species. The remaining cat corresponded to a Persian cat, accounting for 20%.

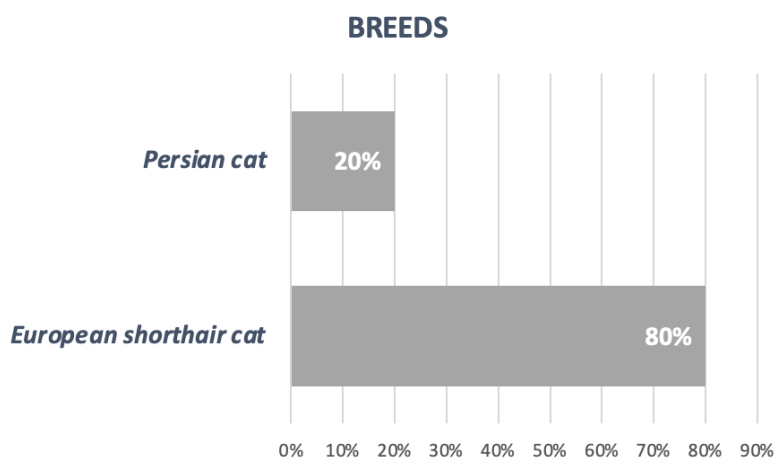


Figure 4: Incidence of feline breeds subjected to enucleation.

- Sex:

The results obtained regarding sex did not differ much in the canine species, as the number of females and males is very similar for both sexes, being 10 of the individuals





females, which represents the 50% of the total number of dogs, and 10 were males, which represents 50% of the total.

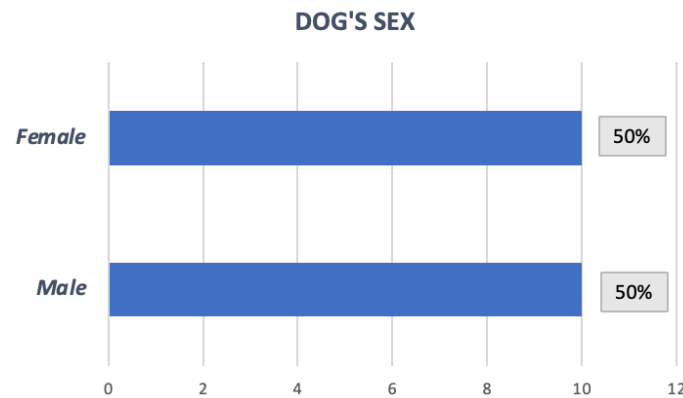


Figure 5: Incidence of enucleation in the canine species according to sex.

Regarding the feline species, it was observed that, of the 5 individuals seen in consultation, 3 of them were males, accounting for 60% of the total, compared to 2 females that accounted for 40%.

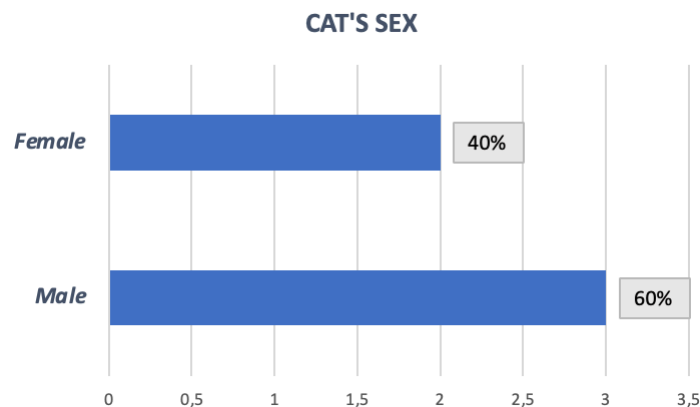


Figure 6: Incidence of enucleation in the feline species according to sex.

Regardless of sex, it was observed that among the 25 cases treated in consultation, there was a slight predominance of males submitted to enucleation compared to females. Males accounted for 13 cases, or 52% of the total, while females accounted for 12, constituting the remaining 48%.





SEX INCIDENCE IN DOGS AND CATS

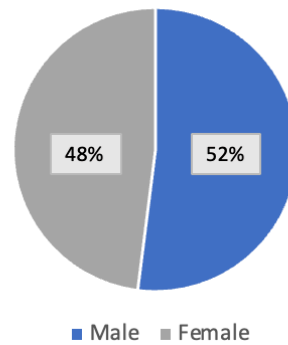


Figure 7: Incidence of enucleation in dogs and cats according to sex.

- Age:

The age of the patients seen by the ophthalmology service and submitted to enucleation was distributed in different ranges, these being animals between 1 month and 1 year, from 2 years to 6 years, from 7 years to 12 years and older than 12 years.

Three animals were recorded that were between one month and one year old. Two of these animals corresponded to the canine species (66.67%) and the remaining animal corresponded to the feline species (33.33%). This range included 12% of the total number of cases registered between dogs and cats in the ophthalmology service. The mean age of this range was 8 months.

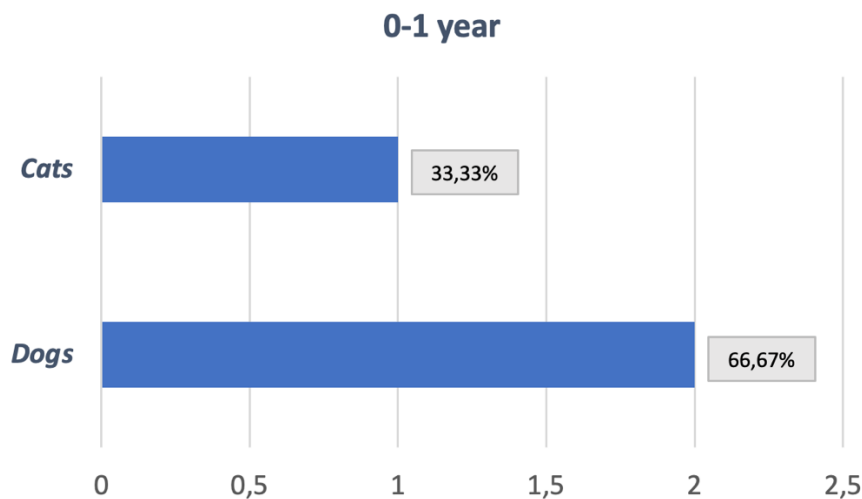


Figure 8: Number of dogs and cats in the 0-1-year interval



As in the previous range, 3 of the patients were between 2 and 6 years old, where two of the animals were dogs (66.67%) and one of them was of the feline species (33.33%). This range included 12% of the total number of registered cases between dogs and cats. The mean age of this range was 5.5 years.

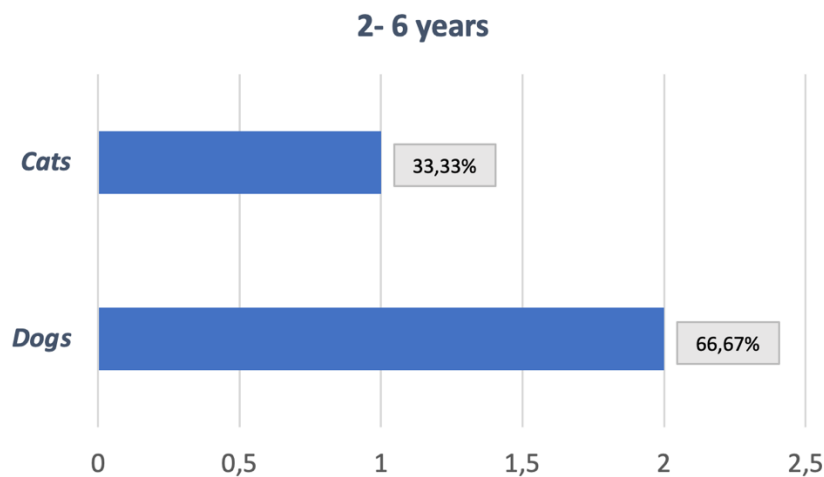


Figure 9: *Number of dogs and cats in the 2–6-years interval*

In the age range of 7 to 12 years, a total of 13 animals were recorded. Of these, two were of the feline species, accounting for 15.39% of the 13 individuals. The remaining 11 animals corresponded to the canine species, which is the 84.61% of the total. This range included 52% of the cases recorded, regardless of the species. The mean age of this range was 10.5 years.



7-12 years

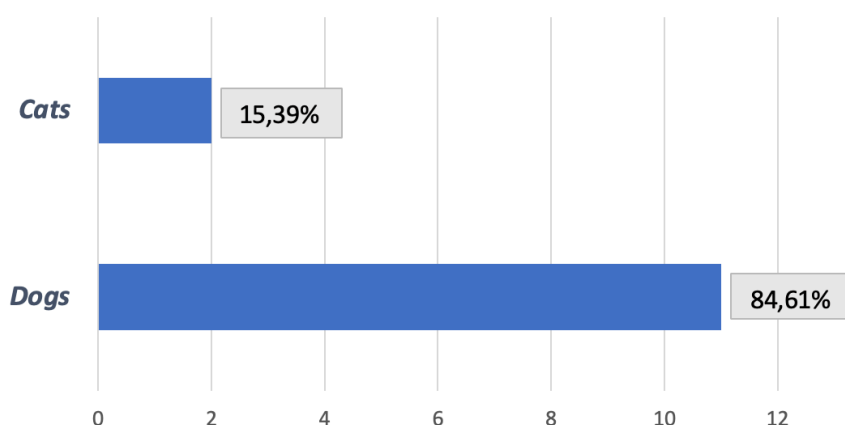


Figure 10: Number of dogs and cats in the 7–12-years interval

Finally, a total of 6 animals were older than 12 years. Among the individuals, one of them was of the feline species, accounting for 16.67% of the total. The remaining 5 patients corresponded to the canine species, accounting for 83.33% of the total. In this range, 24% of the registered cases were included, regardless of the species, and the mean age was approximately 14 years.

> 12 years

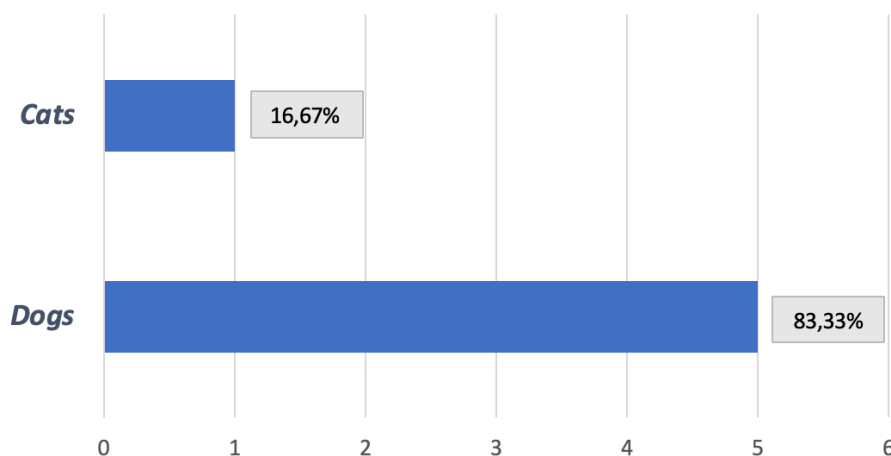


Figure 11: Number of dogs and cats in the interval >12 years old.

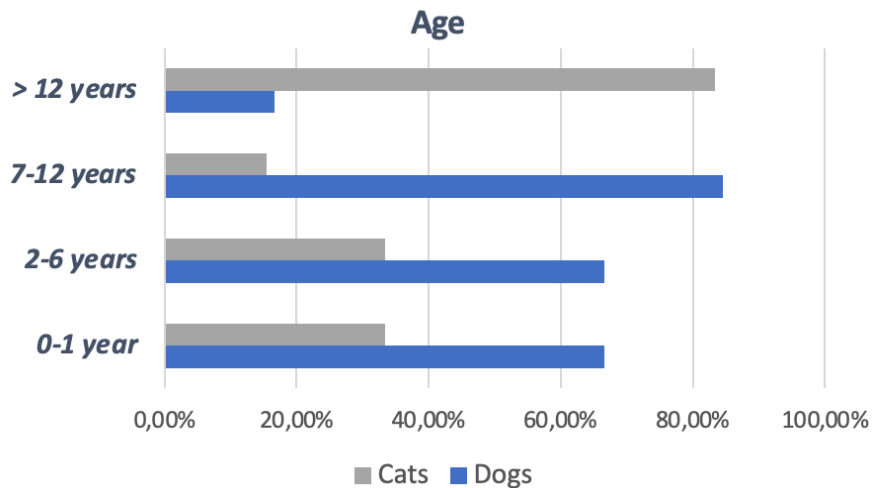


Figure 12: Summary of age incidence of enucleation in dogs and cats

In general, and regardless of the species, the mean age of the animals that underwent enucleation at the Clinical Veterinary Hospital was approximately 9 and a half years.

By species, in the feline species it was observed that of the 5 individuals the mean age corresponded to approximately 7 years and in the canine breed, the mean was 10 years.

- Enucleated eye

In addition to, we evaluated which eye had been enucleated in order to estimate which was the most prone to suffer a pathology whose treatment of choice would have been enucleation.

It was observed that the predisposition to undergo such surgical technique for therapeutic purposes was the left eye. There were 14 animals that underwent this procedure after having suffered a pathology in the left eye, which represents 56% of the total, compared to 11 cases where the enucleated eye was the right eye, which represents 44% of the total number of cases registered, regardless of the animal species.

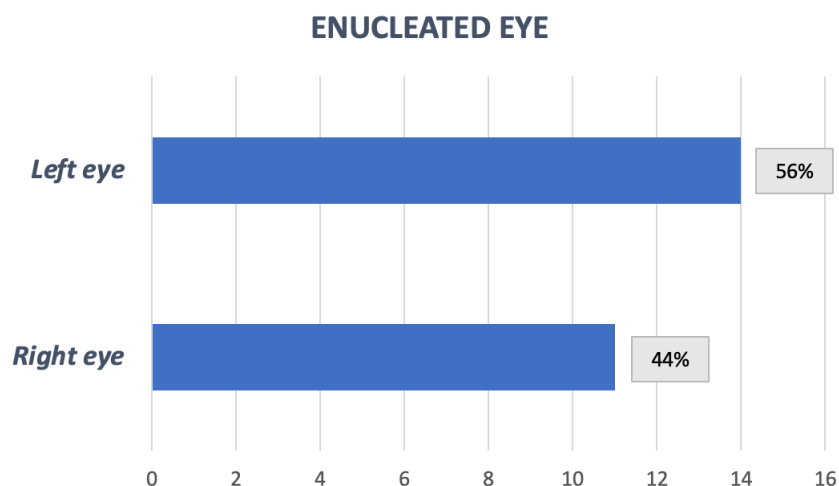


Figure 13: Incidence on enucleated eye

By species, it was observed that of the 5 felines that underwent this surgery, 4 of them had their left eye enucleated, representing 80% of the total, compared to only one individual whose right eye was enucleated, that is, the remaining 20%.

As for the canine species, of the 20 cases recorded, it was observed that the number of right eyes enucleated was the same as the number of left eyes, thus resulting in a 50% incidence in both eyes.

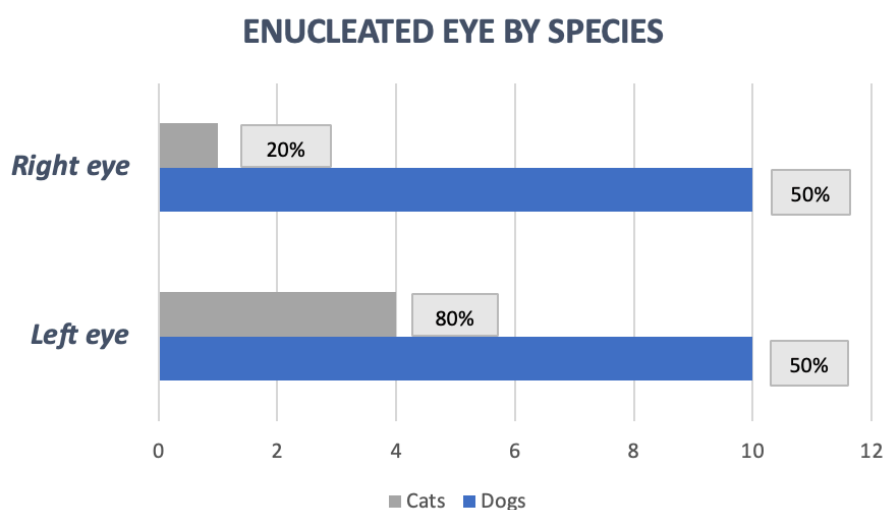


Figure 14: Enucleated eye by species (dogs and cats)



- Reproductive status

Another parameter evaluated was whether the animals were sterilized or not. The findings in this section indicated that most of the animals, regardless of species, had not been previously sterilized before undergoing enucleation as part of the ophthalmologic treatment. Of the 25 patients recorded, 18 were found not to have undergone the sterilization process, representing 72% of the total. In contrast, the remaining 7 cases had been sterilized, equivalent to 28% of the cases.

INCIDENCE OF STERILIZATION

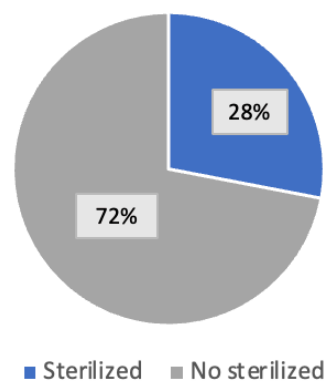


Figure 15: Incidence of sterilization in animals submitted to enucleation.

By species, it was observed that of the 5 cats that were recorded, 3 of them were sterilized, accounting for 60% of the total, compared to 2 of them that had not been spayed or neutered, which is equivalent to 40% of the remaining cases.

INCIDENCE OF STERILIZATION IN CATS

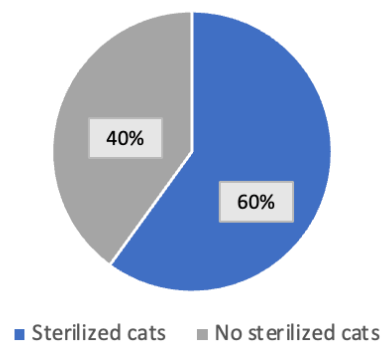


Figure 16: Incidence of sterilization in cats submitted to enucleation.



On the other hand, and in relation to the canine species, we saw that, of the 20 existing cases, only 4 of them had been sterilized, which represents a marked minority that includes 20% of the total. In contrast, the number of canids that had not been spayed or neutered was 16 cases, which represents the remaining 80% of the total.

INCIDENCE OF STERILIZATION IN DOGS

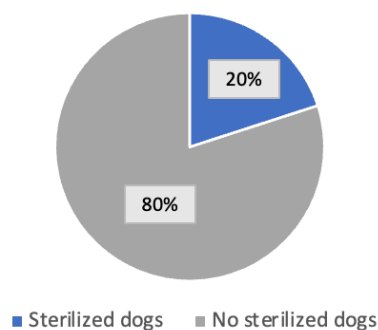


Figure 17: Incidence of sterilization in dogs submitted to enucleation.

- Cause of enucleation

The causes for which enucleation was used as a treatment in the animals registered in the Veterinary Clinical Hospital of the ULPGC were quite diverse, even many of the causes were combined in several animals. Therefore, first, statistical data were obtained on the cause for which this surgical technique had been chosen without considering the species of the animals.

The main cause of enucleation in consultation was due to the presence of glaucoma in the affected eye. Of the total number of cases, 8 were enucleated after having suffered from primary glaucoma without medical resolution. This figure comprises 32% of the cases seen.

The second pathology to top the list was the presence of intraocular neoplasms, which were subsequently sent for anatomopathological diagnosis. Of the 25 cases recorded, 6





of them were diagnosed with neoplasms that required resection of the eyeball, accounting for 24% of the cases, which is also a significant figure.

Thirdly, there were 5 animals that suffered an eye perforation and whose eye had to be removed for medical treatment, which represents 20% of the recorded cases. There were also 5 cases of animals that had suffered ocular trauma, which also accounted for 20% of the total. In addition, 3 of the 25 cases underwent enucleation for therapeutic purposes after ocular prolapse, which is equivalent to 12% of the total number of cases. On the other hand, uveitis accounted for two of the cases registered, representing 8% of the total, as well as 2 cases of ocular dislocation, which also accounted for 8% of the cases.

Finally, there was a single case of deep ulcer and collagenase, which accounted for 4% of the total, as well as a single case of enophthalmia, which also accounted for 4% of the total number of cases registered.

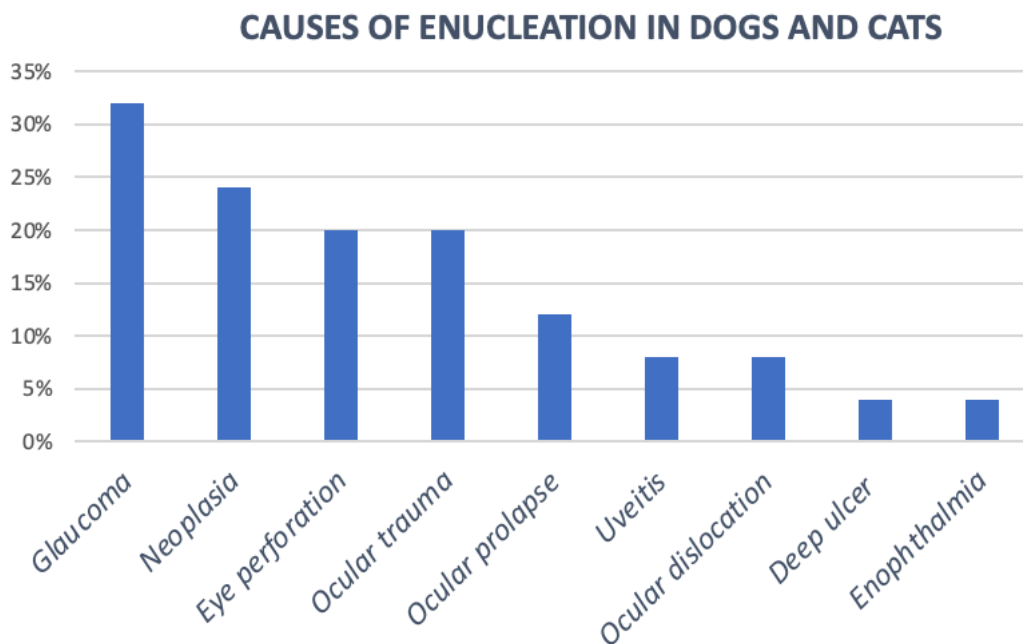


Figure 18: Incidence of causes of enucleation in dogs and cats.



- Comparison in the contralateral eye

In this section, the eye that had not been enucleated was evaluated to see if there were alterations in comparison with the enucleated eye.

In general, and regardless of the species of the animals, it was observed that 11 of the 25 patients did not present any alteration in the eye opposite to the one that had undergone the enucleation surgical technique, which represents 44% of the total. However, the remaining 14 animals did present alterations in the contralateral eye, which is equivalent to 56% of the recorded cases.

ALTERATIONS IN THE CONTRALATERAL

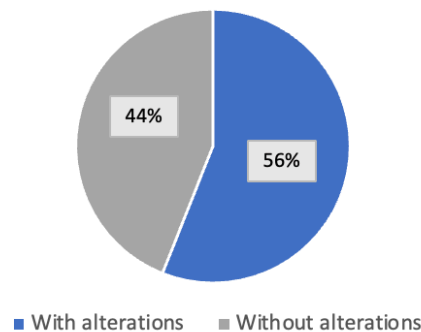


Figure 19: Incidence of alterations in the contralateral eye in dogs and cats.

Of the 14 animals that presented alterations in the healthy eye, different pathologies were observed that were diagnosed and treated by the ophthalmology service, with many of them showing an effective and rapid resolution (Figure 20).

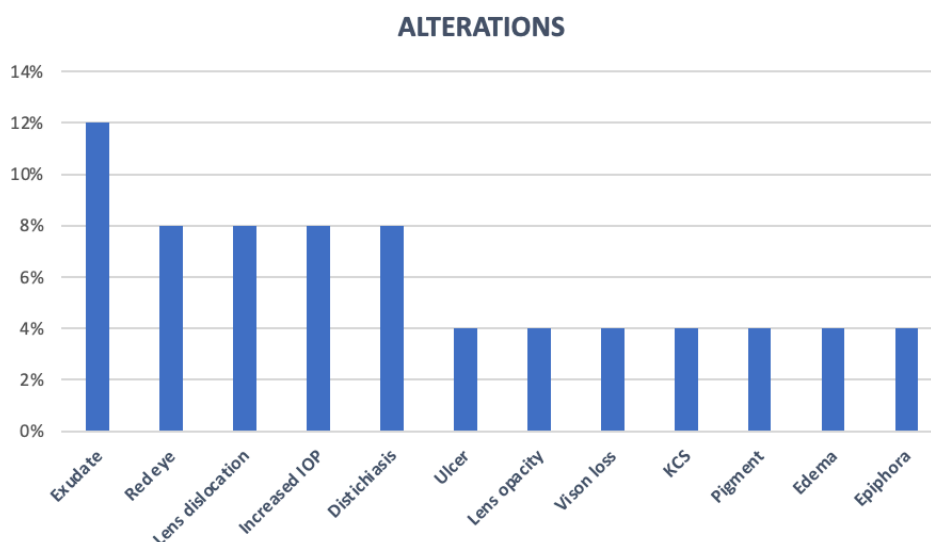


Figure 20: Incidence of alterations observed in the contralateral eye.

-Complications

The number of animals that presented complications after enucleation surgery was 3, which is equivalent to 12% of the total. The remaining 88% had no complications after the surgical procedure, which is the remaining 22 animals.

Among the alterations that the 3 animals suffered, it was found that 2 of the animals presented exudate produced by the placement of the internal stitches, which includes 66.67% of the total number of animals with post-surgical complications. On the other hand, only one of the animals presented a fistula accompanied by exudate, which is equivalent to 33.33% of the total. Finally, one of the animals presented inflammation, produced by the stitches, which accounted for 33.33% of the 3 recorded cases that suffered complications.

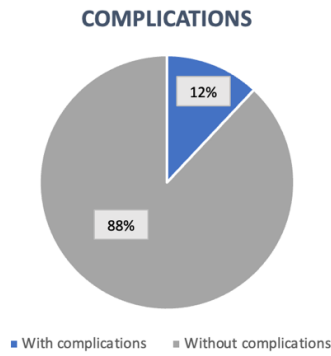


Figure 21: Presence of complications

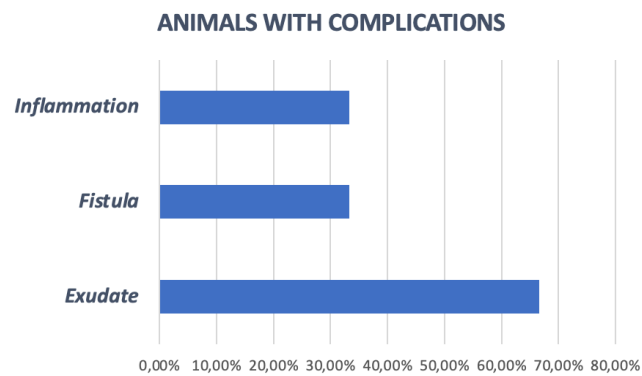


Figure 22: Postoperative complications

In addition, it should be noted that the 3 affected animals corresponded to the canine species, so it was assumed that no feline animal suffered complications after enucleation.



Figure 23: Complications after enucleation. Inmaculada Morales Fariña, HCV-ULPGC 2024.



- Pathological anatomy

Finally, it was noted that of the 25 eyes that had been enucleated, only 9 of them had been sent for pathological anatomy study, equivalent to 36% of the total.

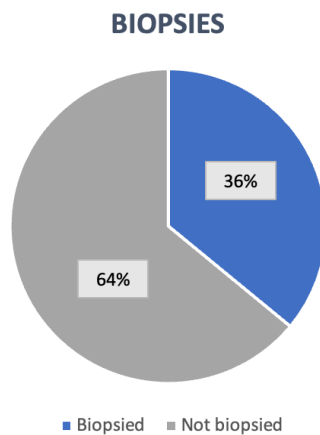


Figure 24: Incidence of biopsy request

- Surgical technique:

In 100% of the cases of animals (regardless of species) whose treatment was enucleation, they underwent the surgical technique of enucleation by subconjunctival or transconjunctival access.

Discussion

The surgical technique used in all the cases registered in this retrospective study was enucleation by subconjunctival or transconjunctival access, which coincides with other studies where this technique has been the technique of choice versus transpalpebral access in most cases, coinciding with the technique used by several authors in surgeries in which enucleation has been chosen.^{5, 6, 7}





- Species

In this study it was observed that most of the patients submitted to enucleation were of the canine species, thus reflecting that there is a greater probability of undergoing this surgery in this species, which coincides with previous studies that include dogs and cats.^{8,9}

- Breed

Regarding the breed, it was observed that in the canine species, Chihuahuas have a higher probability of suffering ocular pathologies whose treatment was enucleation, which coincides with other studies where this breed was more predisposed to undergo this surgery.¹⁰ However, in that same study more cases of Shih Tzu than mongrel dogs were reported, which does not coincide with this project, where only one Shih Tzu was attended in consultation compared to a total of 5 mongrel dogs out of the total, being the breed with the second highest number of cases. The same occurs with dogs of the Yorkshire Terrier breed, with only one individual of this breed in this project, compared to a greater number of cases in the previously mentioned study.¹⁰

On the other hand, in the feline species, it was observed that most of the enucleated eyes belonged to cats of the common European domestic shorthair (DSH) breed, which according to other studies is quite frequent, having been recorded in many cases of enucleation in cats that this breed is the most subjected to this surgical technique.^{6, 11, 12}

- Sex

In the canine species it was observed that the prevalence between females and males was 50% respectively, so no sex prevalence was found in this species. Previous studies reflect a greater predisposition in females compared to males.^{5, 7, 13} However, a study published by I. E. Vlachomitrou, F. Cinti *et al* in 2021 reported a higher incidence of enucleations in males⁶ whose results coincide with those obtained by V. Mezzadri, A. Crotti *et al* in the study published in 2021 where 12 cats and 14 dogs were included.⁹



Contrary, the results obtained regarding sex in the feline species showed a greater variation in the number of females and males registered, observing that the majority of the cases were in cats, with a lower incidence in female cats, adjusting these data to those obtained in studies where the variable of sex in the feline and canine species was of interest.^{6,9}

- Age

The mean age in the canine species was approximately 10 years, coinciding with the fact that most of the dogs registered in this work were in the age range of 7 to 12 years, a result similar to that obtained in the study by Arianne P. *et al* published in 2016 where 31 dogs and 11 cats were included.¹¹ However, in other studies the mean age at which the animals underwent enucleation was 5 years,⁹ which does not coincide with our results.

However, as for the feline species, the mean age at which the animals underwent enucleation was 7 years of age. A different result was obtained in the previously mentioned study,¹¹ although in other studies the result was similar.⁹

- Enucleated eye

Regarding the results obtained regarding which eye was enucleated, in the feline species it was observed that most of the dogs in this study had undergone surgery to enucleate the left eye, which differs from other studies where there was a higher prevalence in the right eye.¹¹

However, in the canine species, it was observed that the incidence of enucleation of both eyes was the same for both the right and left eye. This is not related to the results obtained in the study by Arianne *et al* in 2016.¹¹

In general, and independently of the species, a higher percentage of enucleations was observed in the left eye than in the right eye, which is consistent with other similar studies, where the left eye was enucleated more often than the right eye.¹¹





- Reproductive status

In the canine species, the number of animals that had not been sterilized prevailed over those that had been sterilized, which coincides with the results obtained in other studies, where the number of non-sterilized dogs was higher than the number of dogs that had been spayed.¹¹

On the other hand, it was observed that in the feline species there was a greater number of cats that had been sterilized. Our results are different in comparison with other reported cases where there is a higher prevalence of non-sterilized cats.¹¹

- Cause of enucleation

Enucleation is commonly performed in cases of chronic glaucoma.¹⁴ This pathology was the most frequent cause in this study, the treatment of which was enucleation. Similar results have been reported in previous studies, where the incidence of enucleations due to chronic glaucoma predominates among the results.^{11, 13}

However, other studies show the high incidence of ocular trauma, opting for enucleation as treatment.⁶ Among our results we determined that 20% of the cases had undergone this surgical technique after suffering ocular trauma.

After glaucoma, neoplasia was the second most frequent cause of enucleation. The most frequent ocular neoplasms in veterinary medicine are squamous cell carcinoma, hemangioma and hemangiosarcoma, papilloma, lymphoma, and adenocarcinoma.¹⁵ None of these neoplasms was diagnosed in the cases registered in this study, and various neoplasms such as iridociliary adenoma or diffuse melanoma of the iris were observed in this study.

It is noteworthy that, in the case of the feline species, the most frequent cause of enucleation was neoplasia. Of the two cases, one was an undifferentiated periocular carcinoma and the other a diffuse melanoma of the iris. Given the low number of cats



registered in the study, it is interesting to note that two of them presented this pathology, showing a considerable incidence in this species.

Finally, it is worth noting the high incidence of animals that had suffered an ocular perforation, being 20% of the total cases, a remarkable number given the number of existing cases. Other studies reveal a lower number of animals that have undergone enucleation for this cause.^{11, 13}

- Comparison with the contralateral eye

In the examination of the eye contralateral to the enucleated eye, it was observed that most of the animals presented some symptomatology. Among them, most of the eyes that had not been submitted to enucleation presented exudate. It was then observed that other conditions in the non-enucleated eye included red eye, lens dislocation and increased intraocular pressure.

- Complications

The most frequent complications suffered by animals presenting for consultation after enucleation are hemorrhage and edema, as well as ocular infections. These complications generally appear in the short term, and it is more complicated to observe them in the long term.¹⁶

Regarding the complications suffered by the animals after undergoing enucleation surgery, it was observed that most of them did not present any complications post-surgery, which reflects the favorable recovery of the patients after treatment. Only 12% of the total registered cases presented complications, which corresponds to 3 of the 25 cases in this study. Post-surgical complications of enucleations are more frequent in cases in which orbital implants are chosen, where seroma formation or the appearance of post-surgical infections may occur.¹⁷





In addition, it should be noted that 100% of the animals that presented complications after surgery corresponded to the canine species, with a lower tendency to suffer difficulties after enucleation being observed in the feline species.

Among the complications that appeared after surgery in patients who underwent enucleation, it was observed that the one that appeared in most cases was exudate. In studies where exudate has been one of the emerging complications it was observed that this exudate could be compatible with suppurative inflammation with extracellular cocci,¹⁶ but in our case, it could not be confirmed due to the lack of cytological analysis of the exudate in question.

Another complication that occurred post-surgery were fistulas, whose appearance is mainly due to the incomplete removal of the existing secretory tissues inside the orbit.¹⁸ Draining fistulas of the orbit may be caused by incomplete removal of the caruncle at the medial canthus, incomplete removal of the remaining secretory tissue (e.g. conjunctival goblet cells, third eyelid gland) inside the orbit or defects that may occur in the lid closure.⁴

Finally, inflammation was observed around the incision area due to the placement of the internal stitches, and this complication had a favorable outcome after treatment.

In general, this surgery does not involve post-surgical complications, and this has been reflected in this study, coinciding with authors who have obtained similar results, seeing that these could be resolved in a short period of time,¹³ as occurred in the cases registered in this work.

- Anatomical pathology

The number of enucleated eyes that were sent to anatomic pathology for diagnosis was considerably low, which reflects the need to request this type of test more frequently in order to obtain a definitive diagnosis for the treatment of different ocular pathologies.





Conclusion

Enucleation is one of the surgical techniques used in veterinary medicine that consists of removing the eyeball and part of the optic nerve, ablation of the palpebral margins, the lacrimal gland, the nictitating membrane, and the conjunctival epithelium and involves little risk.

A higher incidence has been observed in dogs than in cats and in older animals. There is a slightly higher incidence of enucleation of the left eye and the most frequent cause for this treatment is glaucoma. Finally, post-surgical complications are almost negligible, but it has highlighted the need to request more biopsies.

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