# Photocoagulation of limbal melanoma in dogs and cats: 15 cases (1989–1993)

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**Objective**—To evaluate immediate clinical effects and long-term results of neodymium:yttrium-aluminum-garnet laser treatment of limbal melanoma in dogs and cats.

**Design**—Retrospective case series.

**Animals**—13 dogs and 2 cats.

**Results**—At the time of treatment, 9 tumors were progressively enlarging and 4 were static. Recent growth characteristics of 2 tumors were not reported. Total energy applied ranged from 7.5 to 572 J. In all eyes, pigmented tissue shrank after treatment; however, 3 tumors recurred, 1 at 3 months and 2 at 1 year after treatment.

**Clinical Implications**—Photocoagulation may be an effective means of treating limbal melanoma in dogs and cats. (*J Am Vet Med Assoc* 1996;208:891–894)

Limbal (epibulbar) melanoma has been described in dogs, cats, horses, and human beings,[1-13] and various authors have reported that 20 to 52% of ocular melanomas in dogs are limbal melanomas.[2,5-7] These are benign melanocytic tumors that may or may not be pigmented[2] and arise from cells at the corneal limbus. Although metastasis has not been reported, these tumors can be locally invasive and, if allowed to grow unchecked, may necessitate enucleation. Previously reported methods of treatment have included full-thickness resection followed by homologous corneoscleral, third eyelid, or synthetic grafting; lamellar keratectomy; partial surgical resection; cryotherapy; beta-irradiation; temporization; various combinations of the aforementioned methods; and enucleation.[2,4,7,10,14,15] Ease of application and morbidity rate vary, as does the probability that the tumor will recur following treatment.

The neodymium:yttrium-aluminum-garnet (Nd:YAG) laser emits light in the near infrared spectrum at a wavelength of 1,064 nm. When the laser is used in the continuous mode, its energy is preferentially absorbed by melanin-containing tissues,[16-18] resulting in coagulative necrosis of pigmented tissues and severe vascular compromise as a consequence of endothelial necrosis.[19] In animals, the Nd:YAG laser has been used to perform posterior capsulotomy following cataract surgery, peripheral iridotomy, and cyclophotocoagulation (eg, for the treatment of glaucoma) and to induce remission of intraocular tumors.[16,20-23] The purpose of the study reported here was to evaluate immediate clinical effects and long-term results of laser treatment of limbal melanoma in dogs and cats.

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## Criteria for Selection of Cases

Medical records of all dogs and cats examined between 1989 and 1993 because of limbal melanoma, diagnosed on the basis of results of clinical examination, were reviewed. Dogs and cats were included in the study only if the tumor had been photocoagulated using an Nd:YAG laser.

## Procedures

A general physical examination and full ophthalmic examination, including slit-lamp biomicroscopy, gonioscopy, applanation tonometry, and indirect ophthalmoscopy, were performed on each dog and cat. Tumor location was recorded by means of line drawings, and tumor size was recorded following measurement with calipers. Involvement of the iridocorneal angle was assessed by means of gonioscopic examination. Gonioscopy also was used to differentiate between limbal tumors and extrascleral extension of pigmented uveal masses. A tumor was assumed to be of limbal origin if it only compressed, but did not involve, the trabecular meshwork and ciliary cleft or if, for tumors that involved the trabecular meshwork and ciliary cleft, these structures and the peripheral portion of the iris were more pigmented than normal and if there was not physical or ultrasonographic evidence of a space-occupying lesion involving the uvea.

Dogs were sedated with thiopental sodium; cats were sedated with ketamine hydrochloride, and laser energy was applied by use of a surgical Nd:YAG laser.[a] A 600-µm quartz fiber delivery system was used. The fiber tip was positioned 1 to 3 mm away from the surface of the tumor, and the laser beam was directed away from the interior of the eye. Laser energy output was verified by use of an external power meter.[b] In most instances, the tumor was biopsied and partially resected with a scalpel blade prior to use of the laser. Specimens were fixed in neutral-buffered 10% formalin, routinely processed for paraffin sectioning, sectioned at 6 µm, stained with H&E, and examined. Additional sections were bleached with potassium permanganate and then stained to facilitate examination of cellular detail.

The total amount of laser energy delivered was determined empirically on the basis of previous experience with cyclophotocoagulation and ablation of intraocular masses and on the basis of tissue reaction. Characteristic effects such as charring and contraction of the pigmented tissues were seen when energy delivery was considered adequate. Postoperatively, animals were treated topically 4 times daily with a gramicidin-bacitracin-polymyxin B ophthalmic solution and 1% prednisolone acetate. Treat-

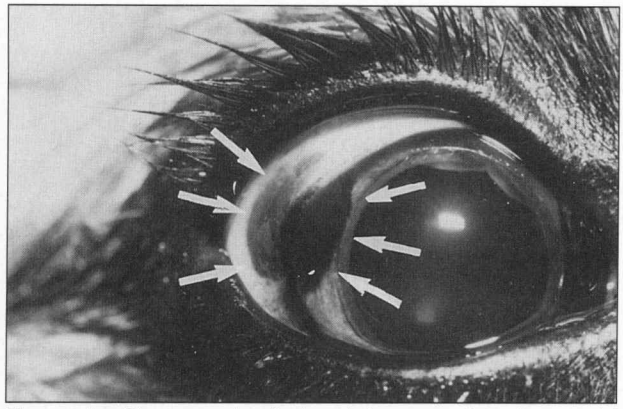

Figure 1—Photograph of the right eye of a 4-year-old mixed-breed dog with limbal melanoma (white arrows). The mass appeared to be elevated above the level of surrounding tissues.

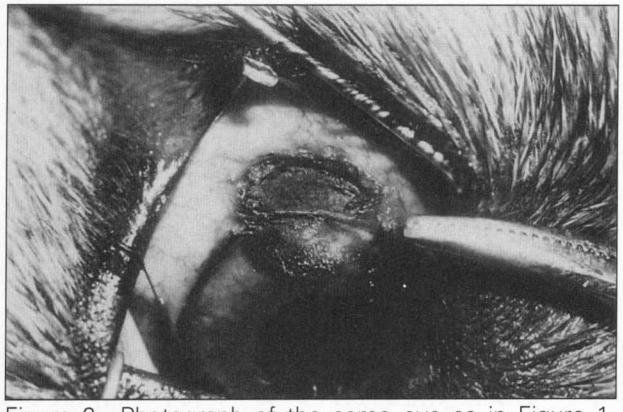

Figure 2—Photograph of the same eye as in Figure 1, immediately following photocoagulation. Notice the characteristic contracted and charred appearance of the pigmented tissues and adjacent unaffected nonpigmented tissues.

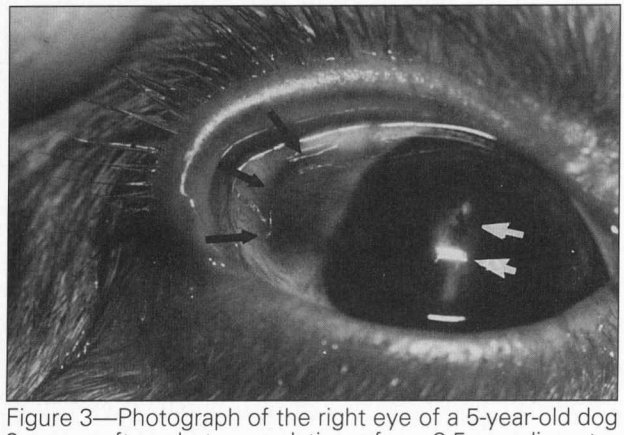

Figure 3—Photograph of the right eye of a 5-year-old dog 2 years after photocoagulation of an 8.5-mm-diameter progressively growing limbal melanoma. Although the area remains pigmented (black arrows), the mass has not enlarged in circumference or become elevated. Notice the adjacent band of corneal degeneration (white arrows), which was present prior to photocoagulation.

ment was considered successful if the pigmented lesion did not increase in diameter or become raised above the level of the surrounding tissue.

## Results

Thirteen dogs and 2 cats met the criteria for inclusion in the study. All were examined because of a dark mass on the surface of the eye that had been noticed by the owner or by the referring veterinarian during an annual examination (Fig 1). Dogs ranged from 2 to 14 years old (mean, 5.2 years). Cats were 5 and 14 years old. Ten animals were male, and 5 were female. All of the dogs were purebred; most were Labrador Retrievers or German Shepherd Dogs. Both cats were of mixed breeding. In 12 of 15 animals, the tumor involved the right eye, and in 14, the tumor was found within the dorsal half of the limbus. In 2 dogs, the tumor involved the iridocorneal angle and peripheral portion of the iris.

Progressive tumor growth was reported by the owner in 9 cases; in 4 cases, owners stated that there had not been any recent growth of the tumor, and in 2 cases, the owners were uncertain whether the tumor had grown recently. The tumor was reported to be progressively enlarging in 7 of the 8 animals $< 5$ years old, but in only 1 (the 14-year-old cat) of the 7 animals $\geq 5$ years old. Tumor growth (progressively growing vs not growing) was found to be significantly associated with age ($< 5$ years old vs $\geq 5$ years old). Fourteen animals had not been treated previously; in 1 animal, the tumor had been treated with cryosurgery 8 months previously.

Immediate effects of laser treatment were contraction and apparent bubbling of the pigmented tissue beneath an intact epithelial surface (Fig 2). Conjunctival and corneal epithelial surfaces were relatively unaffected. Total energy applied ranged from 7.5 to 572 J (mean, 161 J; median, 173 J). Twelve animals were discharged on the day of surgery. In the remaining 3, examination the following morning revealed mild blepharospasm, hyperemia of the conjunctiva, corneal edema, and, occasionally, 1+ aqueous flare. By 2 weeks after surgery, none of the animals had signs of discomfort associated with the treated eye. There was corneal scarring and dispersion of pigment in the treated tissues, but all eyes remained pigmented following treatment. In 3 animals, there was a band of corneal degeneration adjacent to the leading edge of the tumor. This band of degeneration widened during a several-month period following treatment in 1 of these animals, but did not encroach upon the central portion of the cornea. In the other 2 animals, the band of corneal degeneration had not increased in width during follow-up periods of 12 and 46 months (Fig 3). Clinically, these areas of degeneration appeared to be zones of corneal lipid deposition that, presumably, resulted from local metabolic derangement brought about by adjacent tumor growth, postsurgical inflammation, or both.

Tissues from 9 of the 15 animals were examined histologically, and the diagnosis was confirmed in all 9. Tumors consisted of a mixed population of round and spindle-shaped cells containing uniform, deep-brown, intracytoplasmic granules. Mitotic figures were not seen in any of the tissue sections.

Duration of follow-up ranged from 1 day to 55 months (mean, 23.7 months; median, 25.2 months) and was longer than 6 months for 12 animals. The

tumor recurred in 3 animals, 1 at 3 months and 2 at 1 year after surgery. All 3 animals were retreated, and 1 has remained tumor free for 30 months. The tumor was recurrent in the other 2 animals, and 1 and 3 additional photocoagulation treatments were given before the owners decided against further treatment. All 3 tumors that recurred were reported to have been actively enlarging at the time of initial treatment. Neither of the 2 dogs with anterior uveal involvement required retreatment (follow-up time, 12 and 16 months).

## Discussion

Ocular melanomas are the most common ocular neoplasm in dogs and cats,[5,6,8,9,24-29] and are designated by site of origin as anterior uveal, limbal, or choroidal. Although these tumors were previously believed to be highly malignant, the widely held view today is that most are benign but may, nonetheless, cause intractable uveitis or glaucoma and loss of the globe.[7,8,9,23,25,26] Confirmed metastatic rates vary by species and site of tumor origin. Limbal and choroidal melanomas have not been reported to metastasize; however, 4% of anterior uveal melanomas in dogs and 63% of anterior uveal melanomas in cats are metastatic.[26,28] One report[29] suggested that conjunctival melanomas in dogs are more aggressive in terms of local invasiveness and metastatic potential than are other ocular melanocytic tumors.

Many authors have suggested that German Shepherd Dogs are predisposed to development of limbal melanomas. It also has been stated that females have an increased predilection, compared with males, and that this tumor has a tendency to develop in the dorsolateral part of the limbus.[2-9] Because, in previous studies, tumors were evenly distributed between the left and right eyes, it is difficult to explain the tendency toward tumors of the right eye in this series. Martin, in a study of 6 dogs with limbal melanoma,[2] found a bimodal age distribution. Dogs that were 2 to 4 years old had invasive, rapidly growing tumors, whereas dogs that were 8 to 11 years old had slow-growing tumors. A similar age distribution was found in this study; however, other reports have suggested that the age distribution is more even. Limbal melanoma has previously been reported in 4 cats.[10] Biologic behavior and histologic appearance were similar to those reported for limbal melanoma in dogs; however, all 4 cats were ≥ 8 years old.

Because of preferential absorption of laser energy by melanin-containing tissues, the Nd:YAG laser empirically seems well suited to treatment of benign melanocytic tumors. It has been shown that eyes that undergo cyclophotocoagulation for treatment of glaucoma have a mild inflammatory response postoperatively.[19] This suggests that, clinically, the procedure is associated with only mild postoperative discomfort. In this study, successful treatment was defined as a cessation of enlargement of the pigmented tissue. Photocoagulation does not result in removal of pigment, simply the permanent disruption of melanin-containing cells. Presumably, melanocyte necrosis is a result of absorption of laser energy and the resultant thermal effects, vascular compromise caused by endothelial necrosis, or a combined effect.

Only 3 of the 12 tumors followed-up for more than 6 months recurred. It is uncertain whether those tumors that were not progressively growing at the time of initial examination or for which growth status was unknown would have enlarged if treatment had not been undertaken. However, 3 of the 9 tumors known to have active tumor growth at the time of treatment recurred, and 2 of these 3 continued to progress following additional treatments.

Results of this study suggest that photocoagulation may be an effective means of controlling limbal melanoma in dogs and cats. Although the recurrence rate was higher than that previously reported following full-thickness resection, photocoagulation is noninvasive and avoids the sequelae that can sometimes lead to blindness following perforation of the globe during surgery. Photocoagulation also is a simple procedure that does not require prolonged anesthesia and results in low postoperative morbidity rates. Disadvantages to this procedure include the high cost of the equipment and potential regrowth of treated tumors.

[a]Fiberclase 100 Medical Laser System, Laser for Medicine Inc, Hauppauge, NY.

[b]Coherent Commercial Products Division, Auburn, Calif.

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## Effects of topical administration of 0.5% apraclonidine on intraocular pressure, pupil size, and heart rate in clinically normal cats—P. E. Miller and S. L. Rhaesa

**Objective**—To evaluate the effect of a topical $\alpha_2$-agonist, 0.5% apraclonidine, on intraocular pressure (IOP), pupil size, and heart rate in clinically normal cats.
**Design**—Randomized masked saline-controlled case study.
**Animals**—9 clinically normal conditioned adult cats of either sex.
**Procedure**—Normal diurnal variation in IOP, pupil size, and resting heart rate were determined from 7 AM to 7 PM (day 1). On day 2, the same measurements were made after the topical application of 30 µl of 0.5% apraclonidine to 1 randomly chosen eye of each cat. The contralateral eye received saline solution.
**Results**—Apraclonidine lowered IOP a mean of 4.8 mm of Hg (24.0%) when compared with IOP in the fellow saline-treated eye 6 hours after treatment. Unilateral administration of the drug also may have reduced IOP in both eyes. Pupil size was reduced a mean of 46% in only the apraclonidine-treated eye, and miosis persisted for up to 24 hours. Heart rate was significantly lower (11.8%) at 3 hours, and 8 of 9 cats vomited after topical administration of the drug. Mild blanching of the conjunctiva occurred in all apraclonidine-treated eyes.
**Conclusions**—Apraclonidine reduced IOP, pupil size, and resting heart rate in clinically normal cats, but also induced undesirable systemic adverse effects. In contrast to dogs where the drug induced mydriasis, apraclonidine caused miosis in cats.
**Clinical Relevance**—The current commercially available formulation of topical 0.5% apraclonidine is too toxic for clinical use in cats. Reformulation, or identification of a less toxic congener, may result in a clinically useful antiglaucoma preparation for cats. (*Am J Vet Res* 1996;57:83–86)