Color Atlas of Veterinary Ophthalmology

Second Edition

Kirk N. Gelatt and Caryn E. Plummer

WILEY Blackwell

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Preface

Based on the success of the publication of the first edition of *Veterinary Ophthalmology* in 1981, subsequent editions were released in 1991, 1999, 2007, and 2013. The continued expansion and more rapid development of veterinary ophthalmology worldwide resulted in the current fifth edition having 35 chapters, 64 authors, and a text of more than 2100 pages. This second edition of the color atlas presents diseases based on their clinical appearances, and provides introductory information to complement the photos to further understand the characteristics of each disease. The most common eye diseases are emphasized, but to be inclusive, the less frequent diseases (and species) have been added.

Ophthalmology is heavily based on direct clinical examination and diagnostics, and hence often photographed. This heavily pictorial text introduces the veterinary medical student and veterinary practitioner to clinical veterinary ophthalmology based on the clinical appearances of the diseases that one would encounter in small and large animal practice. When possible, multiple photographs of selected ophthalmic diseases are included to demonstrate the different stages of these diseases as presented to the clinician, and when medical and/or surgical therapies alter their appearance. In contrast to most color atlases, we have provide a comprehensive text describing each ophthalmic disease (history, clinical findings, diagnosis, recommended therapy, and prognosis) as well as many species, including dog, cat, horse, cattle, and exotic animals. As a result, this color atlas has the largest collection of clinical photographs currently available in a single book, and for many readers a reasonably complete ophthalmic reference for your veterinary medical library and clinic.

This second edition has added chapters and more than doubled the color clinical photographs from the first edition. The first two new chapters are divided into: clinical anatomy with emphasis on the gross morphology and ophthalmic structures the clinician encounters during his/her clinical examination, and ophthalmic diagnostics most useful in general practice. Chapter 3 illustrates the different ophthalmic tissue responses to diseases common all animals, followed with chapters on canine ophthalmology (Chapters 4–13), feline ophthalmology (Chapter 14), equine ophthalmology (Chapter 15); food and fiber animal ophthalmology (Chapter 16); pet exotic animal ophthalmology (Chapter 17); systemic diseases with ophthalmic manifestations in the dog, cat, horse, and food animals (Chapter 18); and neuro-ophthalmology with emphasis on clinical syndromes (Chapter 19). Appendix 1 is a glossary or condensed selection of ophthalmic words, to assist the reader with sometimes confusing nomenclature (derived from the Greek rather than Latin).

Within each chapter, the diseases are divided into sections on: (1) congenital or developmental; (2) inflammatory; (3) traumatic; (4) degenerative; and (5) neoplasia. Often the text for a color atlas is a single sentence noting the disease. However, for this color atlas, additional clinical information has been included. The text for the color illustrations usually includes: (1) the clinical history; (2) the clinical signs and findings associated with the disease; (3) the rule outs or differential diagnoses; (4) the recommended treatment; and (5) prognosis. If a disease changes its appearance significantly over time or during therapy, multiple illustrations are used.

In diagnostic ophthalmology the clinician relies heavily on direct observations of the ophthalmic tissues and interpretations of these lesions. Only in ophthalmology can the examiner directly observe 2–3 cm into a complex organ, and directly observe the body's vasculature, and part of the central nervous system. There is no substitute or shortcut for a complete ophthalmic examination. The majority of treatment failures are not based on the drug choices or surgical procedures, but because of an incorrect initial diagnosis. The goals of this color atlas are to expand your clinical proficiency and result in improved patient care.

A book of this magnitude and number of photographs has many contributors; the majority from the ophthalmology faculty members, residents, and graduate

students at the University of Florida, College of Veterinary Medicine, during nearly 40 years, and personal veterinary ophthalmology libraries of nearly 60,000 color photographs. Early photographs were recorded by 35 mm color film, and later digitized. Since about 2005, all photographs were digitalized. Additional photographs were provided over the years by other veterinary ophthalmologists, including the late Keith C. Barnett, Paul M. Barrett, Cheryl L. Cullen, Andras Komaromy, Charles L. Martin, Reuben Merideth, Alain Regnier, the late Glenn A. Severin, Ron L. Sigler, Aubrey A. Webb, and many others.

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1

Ocular Anatomy

The Globe

The eye is a very elegant organ, and a wonderful example of the intimate relationship of structure to function. Each part of the eye is designed to achieve or contribute to the special sense of sight. The globe is composed of three basic layers or coats. The outer coat is the fibrous tunic composed of the cornea, the sclera, and the juncture of the two called the limbus. The fibrous tunic gives the eye a constant shape and form which is imperative for a functional visual system. In addition, the anterior portion of the fibrous tunic, the cornea, is transparent, enabling light to pass through, and shaped in a manner that makes it a powerful lens which refracts light rays centrally towards the visual axis of the eye.

The middle layer, or vascular tunic, is the uvea which consists of the iris, the ciliary body, and the choroid. The most anterior portion of the vascular tunic, the iris, extends from the ciliary body centrally just anterior to the surface of the lens. The iris is heavily pigmented and contains muscles which change the shape and size of the iris and the pupillary aperture to control the amount of light that enters the posterior segment to stimulate the retina. The ciliary body is involved in both the production and outflow of aqueous humor, a fluid which flows through the anterior segment. Aqueous humor is secreted from ciliary body processes, which are heavily pigmented central extensions of the ciliary body. Aqueous humor leaves the eye through the iridocorneal angle, a portion of which (the uveal meshwork sinus) is of ciliary body origin. The ciliary body and its processes provide a base on which lenticular zonules are attached. These zonules are fine fibrous bands which attach to the outer portions of the lens and hold it in place. Contractions of ciliary body muscle alter the tension of these zonules and are able to change the shape or position of the lens. This process, called accommodation, alters the degree to which light is refracted. Thus, the lens acts as a fine focusing mechanism, while the cornea serves as the most powerful fixed "lens" of the visual system. The choroid, located in the posterior half of the eye, is found between the outer sclera and the retina. It functions to provide nourishment to the highly metabolic retina and to modify internal light reflection and scatter, as it is either heavily pigmented or reflective. In some species, a special reflective structure, called the tapetum, is located within the choroid and acts to improve photoreceptor stimulation in dim illumination.

The third layer of the eye is the nervous coat which is made up of the retina and associated optic nerve. Briefly, the retina contains light sensitive cells (photoreceptors) which, after a series of intermediate modifying processes, transmit impulses to the brain via the optic nerve.

In addition to the three tunics, additional ocular components fill the interior of the globe: (i) the intraocular fluids (aqueous humor and vitreous humor) and (ii) the crystalline lens.

Aqueous humor is continuously produced by ciliary body processes at a slow rate and fills the anterior and posterior chambers of the eye (between the cornea anteriorly and the lens posteriorly), then drains out of the eye into the bloodstream through the iridocorneal angle to regulate the intraocular pressure of the normal eye. Aqueous humor provides vital nutrients to the avascular lens and cornea and also assists in removing metabolic waste products.

Vitreous humor, a gelatinous fluid, occupies the large chamber in the back of the eye. The vitreous humor helps support and distend the globe and also provides an optically clear medium through which light can pass essentially unaltered.

The crystalline lens is a transparent, avascular, nonpigmented, flattened spheroidal structure lying behind the iris held in place by lenticular zonules. The lens is responsible for focusing light that has entered the eye onto the retina (Figure 1.1).

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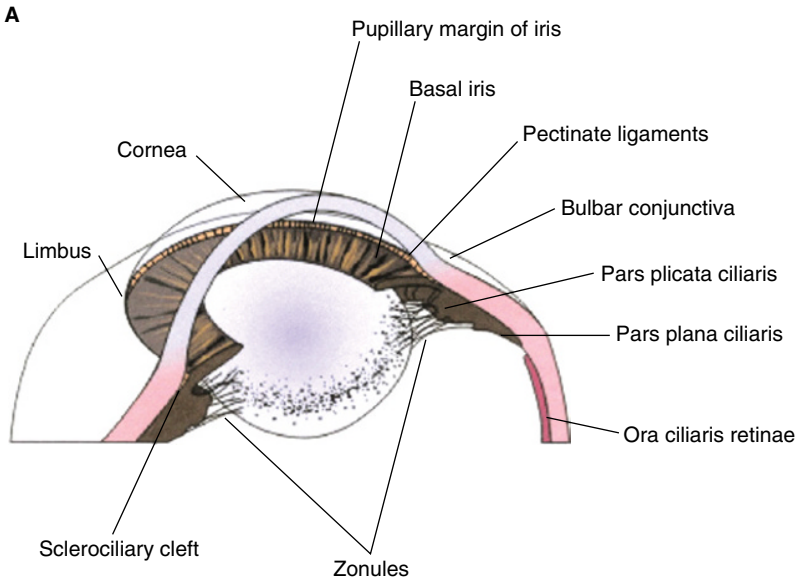
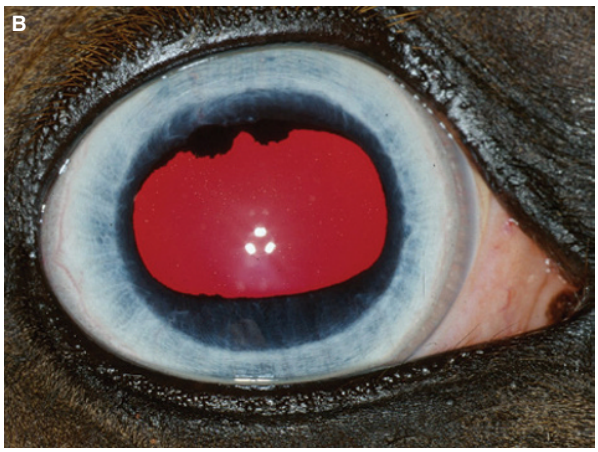




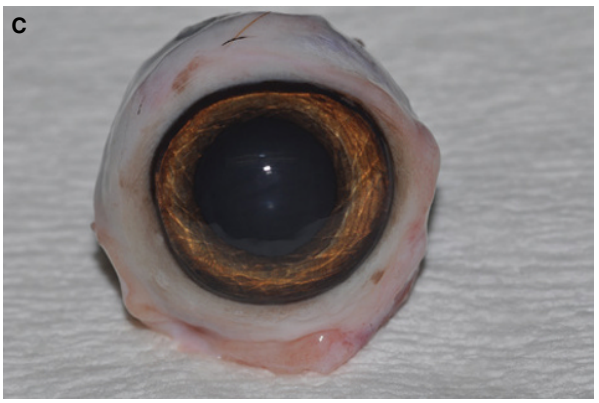
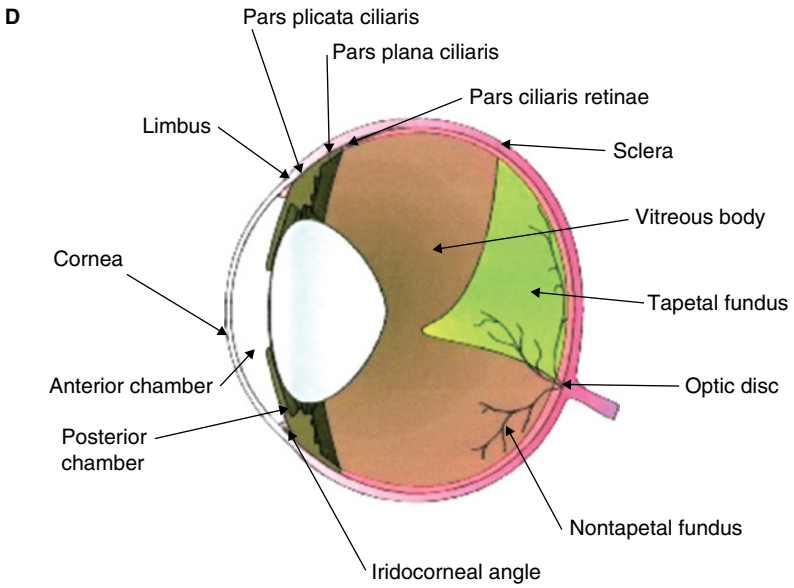
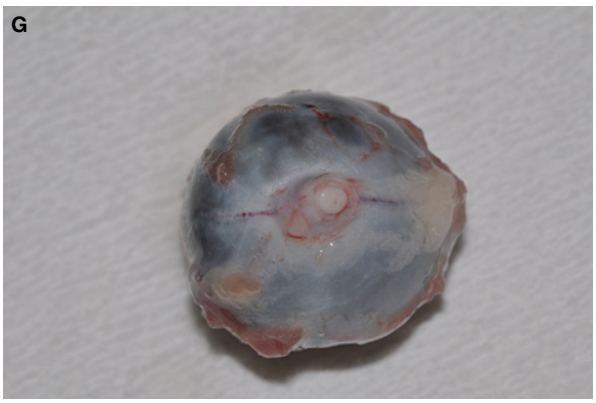
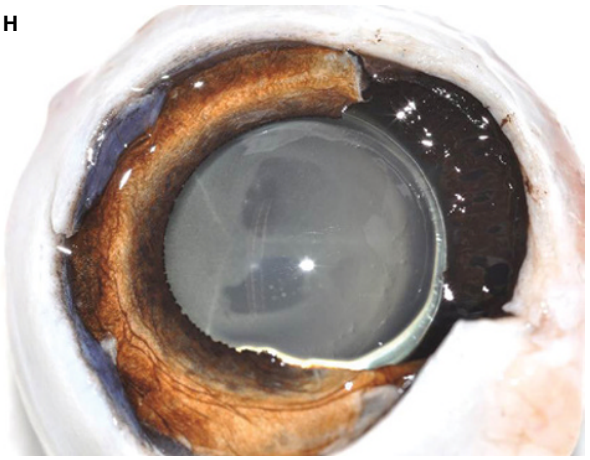


Figure 1.1 (A) The anterior eye showing the cornea, limbus, iris, ciliary body (pars plicata and pars plana), and the zonules that suspend the lens from the ciliary processes. The anterior chamber is the space between the interior cornea and the anterior lens and iris which is filled with aqueous humor. The bulbar conjunctiva covers the sclera which is the posterior continuation of the fibrous tunic (the cornea is the anterior portion). The pupil is the aperture in the center of the iris. (B) A normal horse eye. The iris in this animal is blue in color. There is a pigmented extension of the posterior pigmented epithelium of the iris along the dorsal pupil margin which is called the corpora nigrum or granula iridica. (C) A freshly enucleated canine globe from the front. (D) The globe from the side showing the cornea, limbus, anterior chamber, iridocorneal angle, posterior chamber, ciliary body (pars plicata, pars plana, and the ciliaris retinae), vitreal chamber, sclera, and optic nerve. The fundus is divided into tapetal and nontapetal sections. The tapetum is located within the dorsal choroid. The choroid, or the posterior aspect of the vascular tunic, lies interior to the sclera (the anterior extension of the vascular tunic is the ciliary body and the iris) and the retina lies interior to the choroid and adjacent to the vitreous body. (E) A normal horse eye in profile. (F) A freshly enucleated canine globe in profile. The optic nerve is observed extending from the posterior aspect of the globe. (G) Posterior aspect of a freshly enucleated canine globe. Running along the sclera anteriorly at the 3 and 9 o'clock positions are the long posterior ciliary arteries. These are important landmarks for surgical approaches to the eye. The insertions of the extraocular muscles (the muscles themselves have been removed) which move the globe are appreciable. (H) In this prosection, the cornea and a sector of the iris have been removed to reveal the lens equator and the ciliary body behind. (I) In this prosection, the cornea, and the anterior uvea have been removed revealing the lens sitting within the patellar fossa of the vitreous. (J) The lens has been removed from the globe and placed upon a page of type. Note the clarity and the magnification. (K) In this prosection, the anterior segment and lens have been removed, revealing the retina (artifactually detached in areas), the retinal vasculature, the tapetum in the dorsal choroid, the pigmented nontapetal fundus, and the optic disc. (L) Prosection of the posterior globe. In this example, the globe has been cut in order to flatten it. Source: (A, D) Gelatt KN and Gelatt JP 2011. Reproduced with permission of Elsevier.







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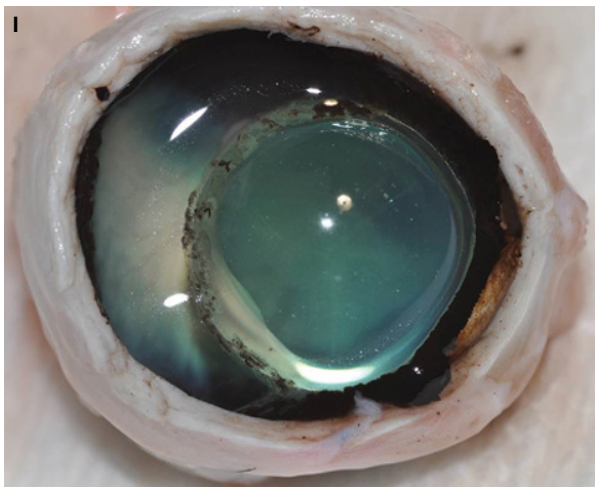


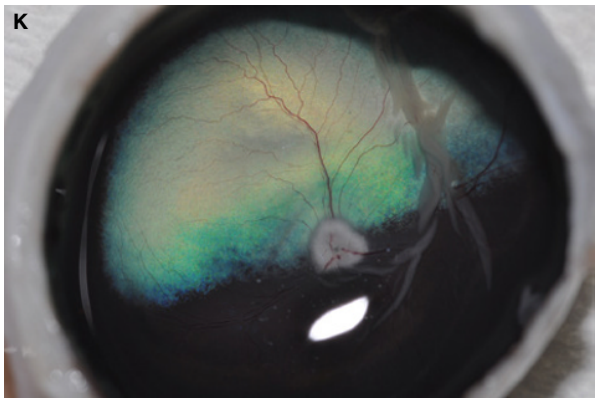


Figure 1.1 (*Continued*)

The Adnexa

The orbit is a bony fossa that separates the eye from the cranial cavity, surrounds and protects it, and provides several pathways through foramina for the various blood vessels and nerves involved in the function of the eye. The orbit in the dog and cat is an incomplete bony orbit composed of five, sometimes six bones, the supraorbital ligament, and the periosteum. The ruminant large animals usually have enclosed orbits. Closure of the temporal side of the orbit is accomplished by the union of the zygomatic bone and the frontal bone. The enclosed orbit is essential for protective purposes.

The eyelids are dorsal and ventral folds of thin skin continuous with the facial skin. The free edges of the dorsal and ventral lids meet to form the lateral and medial canthi. The opening formed by the free edges is the palpebral fissure. The fissure is prevented from assuming a circular shape by medial (nasal) and lateral (temporal) palpebral ligaments which attach the canthi to the orbital wall. The medial ligament inserts into periosteum of the nasal bones whereas laterally it inserts into temporal fascia. The lateral ligament is absent or rudimentary in the dog and is replaced by the retractory anguli oculi muscle. Closure of the eyelids is achieved by the contraction of the orbicularis oculi muscle located deep in the lids around the palpebral fissure. Opening or parting of the lids is by relaxation of the orbicularis oculi and contraction of the levator palpebrae superioris which inserts on the orbicularis oculi muscle.

The free margin of the eyelid can contain a row of cilia or lashes. These lashes are directed away from the anterior surface of the cornea. The inner surface of the lids is lined with a mucous membrane, the (palpebral) conjunctiva. The conjunctiva is reflected onto the globe (bulbar conjunctiva). The junction between the palpebral and

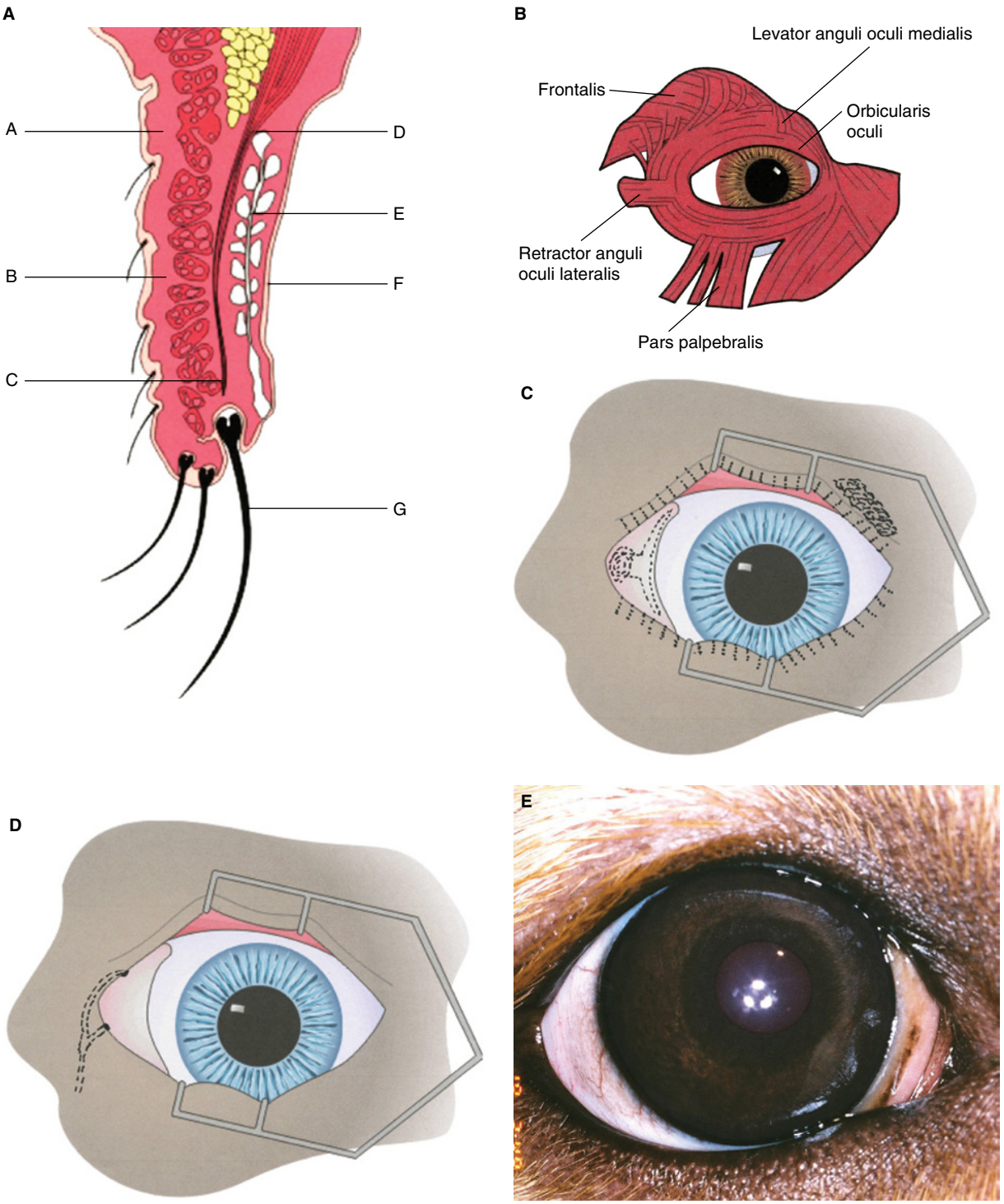


Figure 1.2 (A) The eyelids. A. Haired skin. B. Orbicularis oculi (eyelid musculature responsible for closure of the palpebral fissure). C. Tarsal plate. D. Insertion of the levator palpebrae superioris (responsible for elevation of the upper eyelid). E. Meibomian glands. F. Palpebral conjunctiva. G. Cilia (eyelash). (B) The eyelid musculature showing the muscles of facial expression and eyelid movement. The levator palpebrae superioris and the Müller's muscles, responsible for eyelid opening, are not shown. (C) The location of the lacrimal glands (orbital and gland of the third eyelid) and the meibomian glands lining the upper and lower eyelids along their margins. (D) The location of the lacrimal puncta of the nasolacrimal apparatus in the medial canthus and the subcutaneous pathway into the nasolacrimal duct. (E) A normal dog eye. Note the apposition of the eyelids to the globe, the smooth, regular margins of the lids and the third eyelid, and the normal appearance of the conjunctiva and the nictitans. Source: (A-D) Gelatt KN and Gelatt JP 2011. Reproduced with permission of Elsevier.

bulbar conjunctiva is the fornix. The conjunctiva is the most exposed of all mucous membranes. Its primary functions are preventing dessication of the cornea, increasing mobility of the eyelids and globe, and providing a barrier against microorganisms and foreign bodies. Ventrally, an additional fold is formed by the reflection of the conjunctiva over the nictitans. The nictitans (third eyelid) is a large, semilunar fold of conjunctiva that protrudes from the medial canthus over the anterior surface of the globe (from the dorsomedial orbit in birds). It contains a cartilaginous plate which is T-shaped, the horizontal part of it being parallel with the free edge of the membrane. The nictitans gland surrounds the caudal end of the shaft of the cartilaginous plate with the majority of the gland on the bulbar surface. It produces approximately 30% of the tears. The largest lacrimal gland, which is responsible for producing the majority of the aqueous tears, is located in the dorsal orbit.

Visible through the conjunctiva on the posterior surface of the eyelid margin are the meibomian glands. These form parallel rows of lobules which have their ducts opening close to the lid margins. The glands in the distal eyelid stroma are sebaceous in nature and contribute to the oily component of tear film. Each gland is made of a number of holocrine acini which are arranged in vertical columns and open into a central duct.

The tear film is considered an anatomic structure as well. This fluid covering the partially exposed anterior segment of the globe is necessary for maintaining an optically uniform corneal surface, removing foreign material and debris from the cornea and conjunctival sac, providing oxygen and other nutritional requirements to the cornea, and preventing the development of ocular surface infections. It normally consists of an aqueous component, a lipid component, and a mucous component. Aqueous tear fluid, once it has fulfilled its duties, drains through lacrimal puncta in the upper and/or lower eyelids at the medial canthus into the nasolacrimal sac and duct which subsequently drain into the nasal passages or the oropharynx (Figure 1.2).

2

The Ophthalmic Examination and Diagnostics

A thorough ophthalmic examination can provide a rapid and accurate diagnosis for many ophthalmic diseases, because most ocular structures can be visualized either directly or indirectly. Furthermore, the eye lends itself to numerous simple and efficient diagnostic procedures, many of which can be performed during a routine examination. This chapter demonstrates examination and diagnostic techniques. Most of these procedures are noninvasive, and a thorough understanding of them can facilitate the identification and diagnosis of many ocular disorders.

The basic equipment necessary to perform a proper ocular examination includes a bright, focal light source (a Finoff transilluminator is ideal), Schirmer tear test strips, ocular stains (vital dyes), topical anesthetic, mydriatic agent, eyewash, sterile culture swabs, forceps, surgical blades, glass slides, cannulas for nasolacrimal duct irrigations, and an ophthalmoscope for examination of the fundus. Magnification is very helpful to identify small or subtle lesions.

The eye examination must be complete, organized, and strategic. Certain tests or observations must precede others to avoid interference or spurious conclusions. If indications for microbiologic sampling are present, samples are taken on moistened sterile swabs before instillation of any diagnostic drugs (stains, mydriatics, local anesthetics) as they can contain preservatives that prevent microbial growth. The Schirmer tear test must be performed before excessive ocular manipulation and instillation of any ophthalmic solutions or ointments, otherwise the result will be an inadequate reflection of tear production. The pupillary light reflexes should be evaluated before mydriatics or miotics are used. Similarly, measurement of intraocular pressure (IOP) should precede instillation of mydriatics. A thorough examination assesses all ocular and periocular structures, outside to inside and front to back. Accurate recording of examination will permit assessment of progress (Figure 2.1).

External Examination

The ophthalmic examination begins with an indirect assessment of vision (menace response, visual placing, maze testing) and comfort, and should be performed prior to sedation and nerve blocks, if these are necessary. The distant evaluation assesses the size, position, and direction of the globe and its movements. Any ocular discharge and asymmetry should be noted. It is important to examine each eye successively and to assess ocular and adnexal structures for symmetry.

The distant examination should be performed from different angles when facing the patient as subtle changes in globe position can become apparent when viewing, say, from above the animal's head. Evaluation of ocular movements can be achieved by turning the animal's head from side to side. Normal saccadic and optokinetic movements are noted as the eyes move back and forth in synchronicity, with the fast phase occurring in the direction of head movement. Complete external examination should include palpation of the orbit and retropulsion of both globes (Figure 2.2).

Nerve Blocks

Akinesia of the palpebral or auriculopalpebral (branch of palpebral) nerves facilitates examination of the eye in large animals, particularly equids. There are three main points at which the auriculopalpebral or palpebral nerves can be blocked in the horse. The first is just anterior to the base of the ear where the auriculopalpebral nerve emerges from the parotid salivary gland and becomes subcutaneous on the lateral aspect of the coronoid process. Here local anesthetic can be injected into the depression just caudal to the ramus of the mandible at the ventral edge of the temporal portion of the zygomatic arch. The rostral auricular artery and vein should be

Color Atlas of Veterinary Ophthalmology, Second Edition. Kirk N. Gelatt and Caryn E. Plummer.

avoided. The second is just lateral to the highest point of the caudal zygomatic arch where the palpebral nerve can be "strummed" under the skin over the dorsal border of the bone. The third is where the palpebral nerve lies on the zygomatic arch caudal to the bony process of the frontal bone (Figure 2.3).

Tear Film Assessment

The nasolacrimal system has both secretory and drainage functions. Evaluation of this apparatus should note any tearing or hypofunction, as well as the endpoint of drainage. Excessive tearing can be caused by partial or complete obstruction of the drainage apparatus and increased lacrimation by ocular irritation and uveitis. The quality and quantity of the tear secretion is indirectly assessed by observation of the normal preocular tear film, which consists of three main components. The middle, or aqueous, layer is produced primarily by the lacrimal and nictitans glands in mammals, and deficiencies can be identified via the Schirmer tear test (Figure 2.4). The folded end of the Schirmer tear test strip is inserted in the lower conjunctival fornix, in contact with the cornea, near the junction of the middle and temporal thirds of the eyelids where it should remain for 1 minute. Tears are measured from the fold of the strip in millimeters per minute, immediately following removal. In common domestic species, tear production greater than 15 mm/minute in the absence of disease is considered adequate. The inner, mucin layer of the tear film is produced primarily by conjunctival goblet cells and the outer, lipid layer is produced by the meibomian glands in the eyelids. Deficiencies of the outer and inner layers result in qualitative dry eye. These can be assessed by tear film break up time (rapid evaporation) which utilizes topical fluorescein, rose Bengal, or lissamine green stains to delineate foci of mucin absence.

The passage of tears through the nasolacrimal duct can be indirectly observed with fluorescein passage (Jones' test). If fluorescein is not observed at the nares, active flushing, or the injection of normal saline solution through the nasolacrimal drainage apparatus either orthograde (i.e., from the lacrimal puncta) or retrograde (i.e., from the distal nare's opening), can be performed.

Corneoconjunctival Culture

Culture and sensitivity testing provide useful information for the diagnosis and determination of appropriate antimicrobial therapy in many corneal and conjunctival diseases. Cultures should be obtained very carefully from any deep or progressive corneal ulcers, or those that fail to heal in a reasonable amount of time. Cultures can also be taken from purulent or granulomatous conjunctival lesions or from animals with chronic conjunctivitis that does not respond to therapy. Both corneal and conjunctival cultures should be obtained early in the ophthalmic examination, before administration of topical solutions or ointments (Figure 2.5).

Corneoconjunctival Cytology

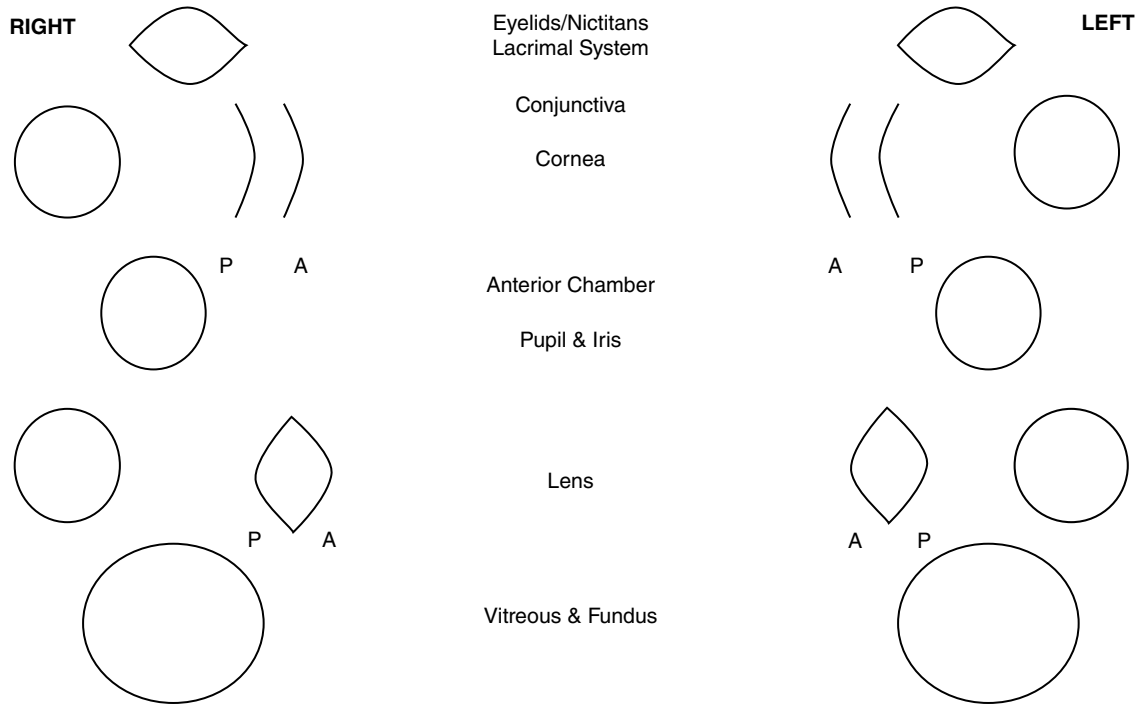
Corneal or conjunctival cytology is extremely useful in the diagnosis of certain forms of inflammatory or neoplastic conditions and is very helpful for the planning of

Figure 2.1 (A) Essential equipment for ophthalmic examination.

B

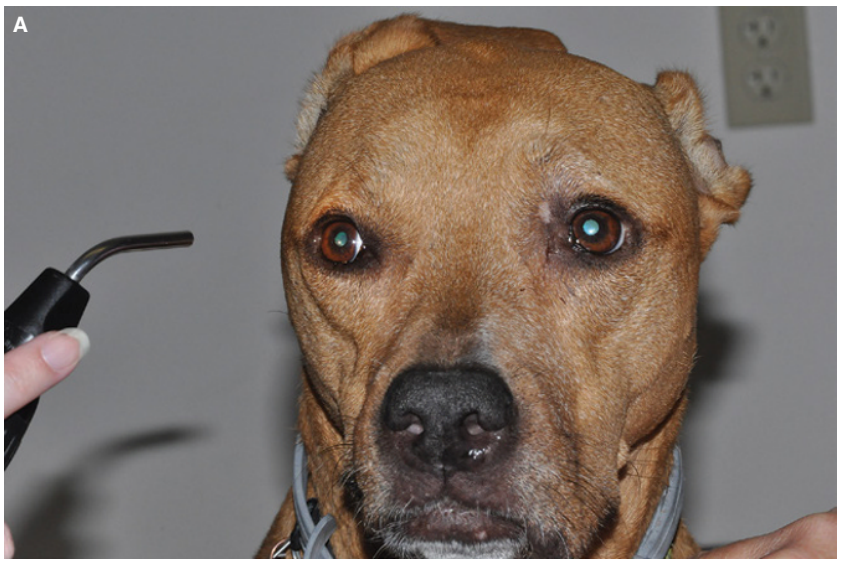
Patient Label Here	Faculty/Resident/Student:	Date:
	Diagnosis:	
Present Treatment:	Recommended Treatment:	

Reflexes	**Right**	**Left**	**Tests**	**Right**	**Left**
Direct PLR	+ / –	+ / –	Schirmer Tear Test	mm/min	mm/min
Consensual PLR	+ / –	+ / –	IOP	mmHg	mmHg
Menace	+ / –	+ / –	Fluorescein	+ / –	+ / –
Dazzle	+ / –	+ / –	Jones Test	+ / –	+ / –
Palpebral	+ / –	+ / –	Rose Bengal	+ / –	+ / –



Special Procedures:		Sedation: _____
ERG: ☐	Culture: ☐	General Comments:
Gonioscopy: ☐	Cytology: ☐	
N-L Flush: ☐	Ultrasound ☐	
Photography: ☐	Other: ☐	
_____		

Figure 2.1 (*Continued*) (B) An example of an examination form for recording findings.



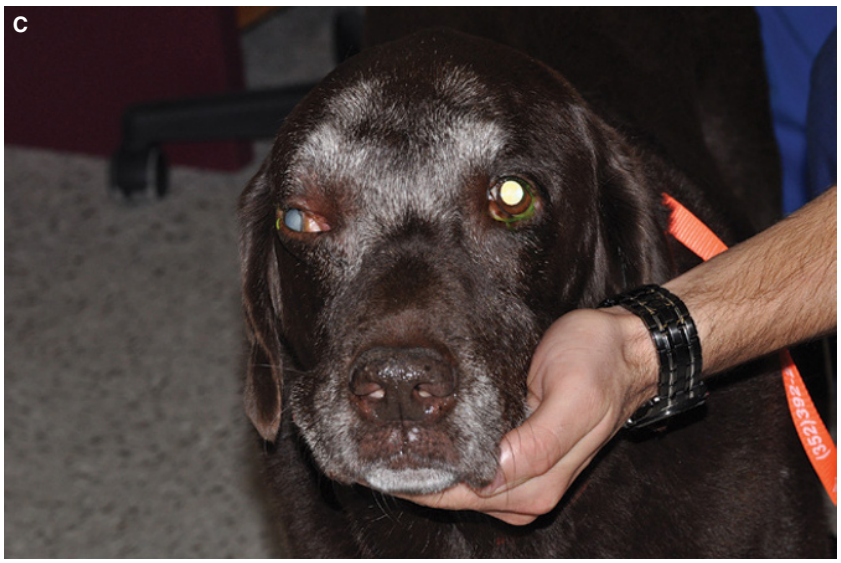


Figure 2.2 (A) Pupillary light reflexes should be assessed with a bright light (here, a Finoff transilluminator is being used) in both bright and dim lighting conditions. (B) Retropulsion of the globes should be equal on each side and nonpainful to the patient. (C) Assessing the patient for asymmetry is an important part of the ophthalmic examination. In this case, a retrobulbar mass has resulted in relative exophthalmos and strabismus. Radiation therapy has resulted in cataract formation and whitening of the hair coat.

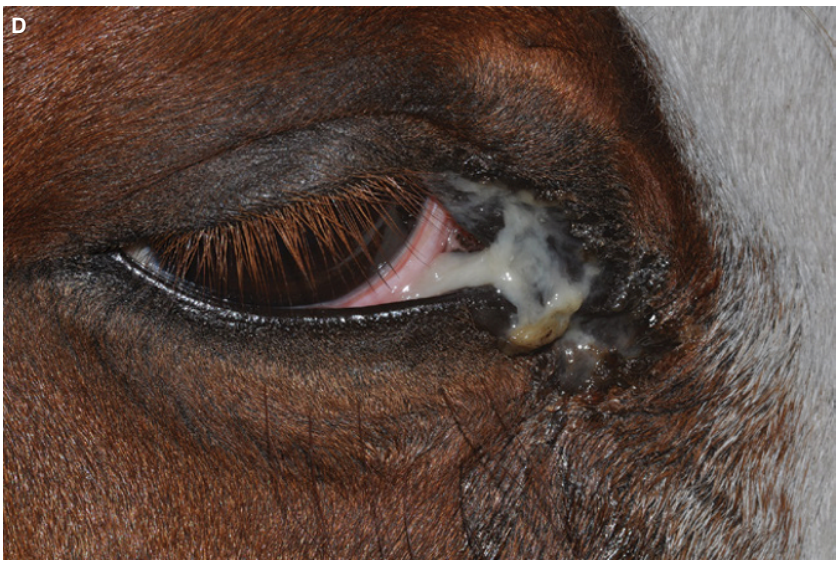


Figure 2.2 (*Continued*) (D) Characterization of any ocular discharge can help with diagnosis and staging of severity and chronicity of ocular conditions.

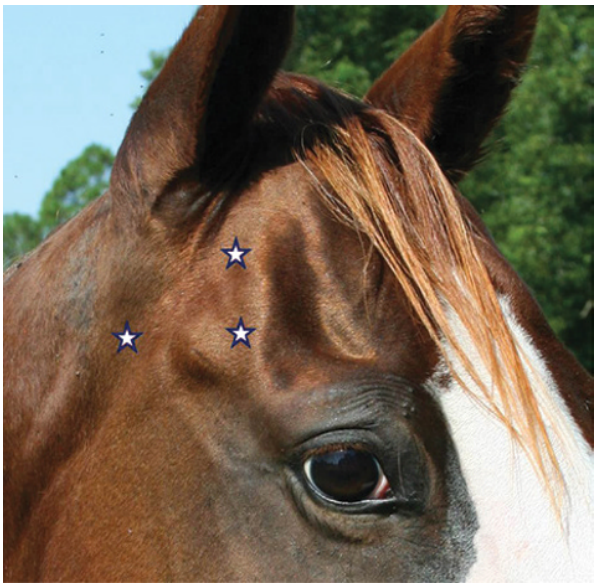


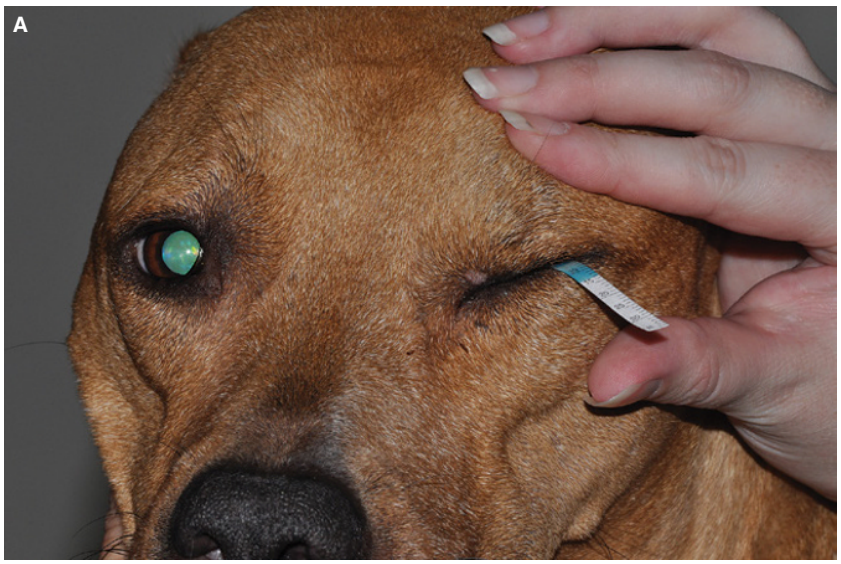
Figure 2.3 Landmarks for the auriculopalpebral motor block to facilitate a complete ophthalmic examination in a horse.

empiric therapy for corneal ulcers. Instruments for collecting cytologic samples include cotton or Dacron swabs, cytobrushes, spatulas (Kimura platinum spatula), and the blunt end of a scalpel blade (Figure 2.6). Impression cytology can also be used for sample collection in some instances. Topical anesthesia (i.e., 0.5% tetracaine or 0.5% proparacaine) should be applied to the ocular surface prior to sample acquisition, and care must be taken to avoid ocular trauma.

Ophthalmic Stains

Fluorescein dye is used to detect corneal and conjunctival defects, aqueous humor leakage (Seidel's test), precorneal tear film (PTF) deficiencies (tear film break-up time; TFBUT), and to assess nasolacrimal duct patency (Figure 2.7). TFBUT is a measure of the stability of the PTF which involves recording the time it takes for fluorescein applied to the ocular surface to dissipate, or the PTF to dissociate (dark spots in a diffuse film of fluorescein will develop and indicate break-up). Patency of the nasolacrimal apparatus is tested by applying sodium fluorescein to the eye and timing the passage of fluorescein through the system to the external nares (i.e., Jones' test). This dye is hydrophilic, binding readily to exposed corneal stroma when ulcers are present. The dye will not bind to intact healthy corneal epithelium, however, or to the endothelium and Descemet's membrane.

Rose Bengal is used to assist in the diagnosis of PTF disorders (mucin deficiency) and superficial corneal epithelial abnormalities. Besides being used to assess the integrity of the PTF, rose Bengal can also be used to demonstrate very small superficial ulcers and erosions such as the punctate corneal lesions often present in early stages of keratomycosis in the



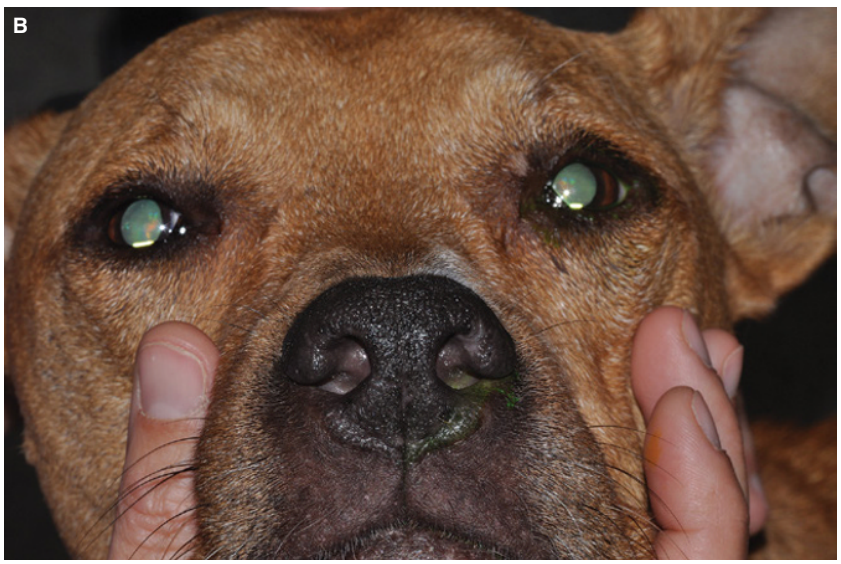
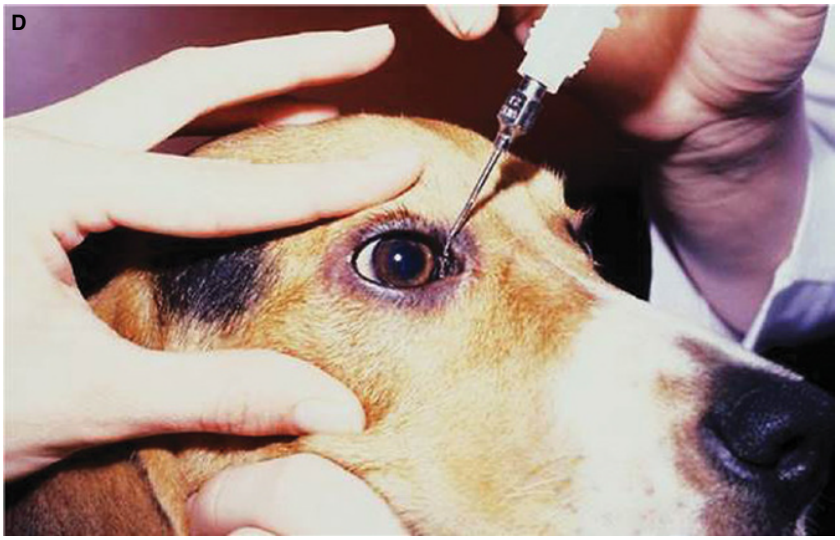


Figure 2.4 (A) Schirmer tear test 1 being performed in a dog. The notched end of the strip is inserted behind the eyelid margin along the lateral lower eyelid so that it comes into contact with the globe. (B) Nasolacrimal patency can be assessed indirectly with the application of topical fluorescing stain to the ocular surface. After several minutes, the dye should be seen exiting the nares (Jones' test positive). Note the green colored nasal discharge from the left nare. (C) Cats may not have fluorescein exit from their nares. Some individuals drain tears into their oral pharynx, so assessment of nasolacrimal patency includes opening the mouth and observing the base of the tongue for fluorescein.



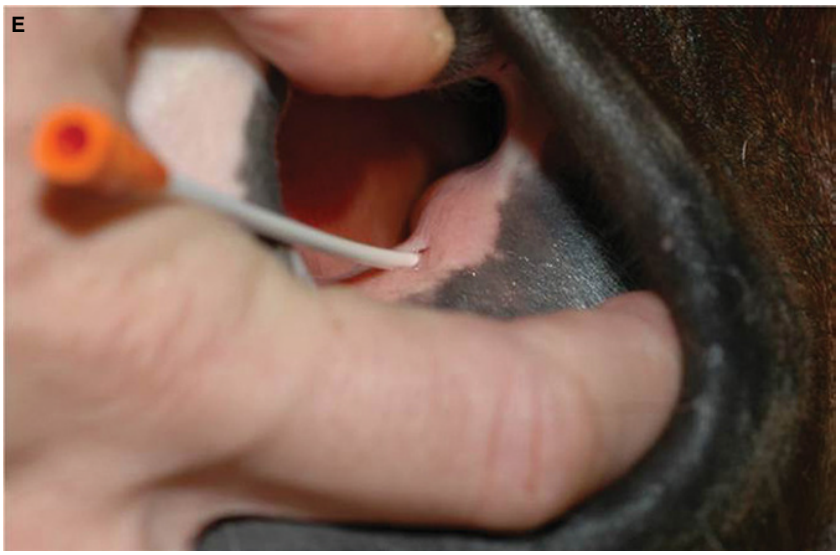


Figure 2.4 (*Continued*) (D) If the Jones' test is negative, the next step in assessing patency of the nasolacrimal apparatus is to flush the nasolacrimal duct manually. After application of a topical anesthetic, a small cannula is introduced into one of the lacrimal puncta. Mild pressure is applied to force fluid through the duct. If it does not flow appropriately, dacryorhinocystography should be considered. (E) Flushing of the nasolacrimal duct in horses is usually performed retrograde from the nasal punctum.

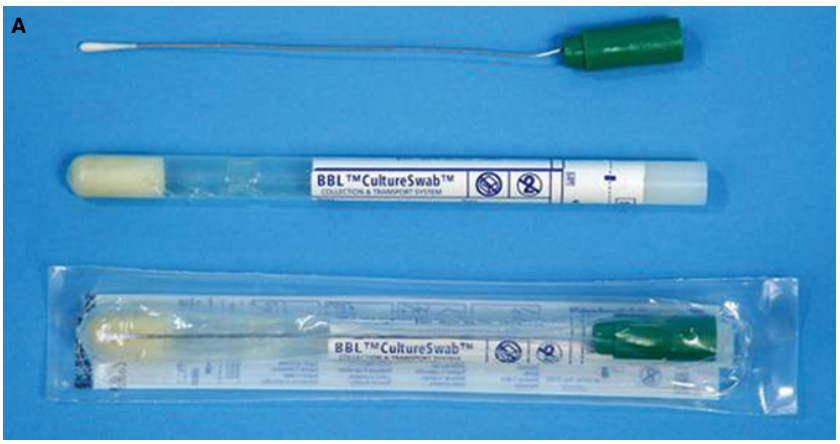
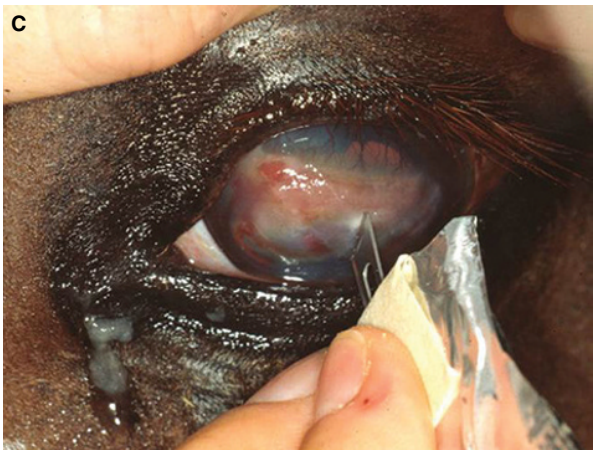


Figure 2.5 (A) Equipment employed in sample acquisition for microbial culture and susceptibility testing.

Figure 2.5 (*Continued*) (B) Taking a sample for microbiologic culture and susceptibility testing.

Figure 2.6 (A) The basic equipment necessary to perform cytology. (B) Taking a corneal sample from a melting corneal ulcer with a cytology brush.



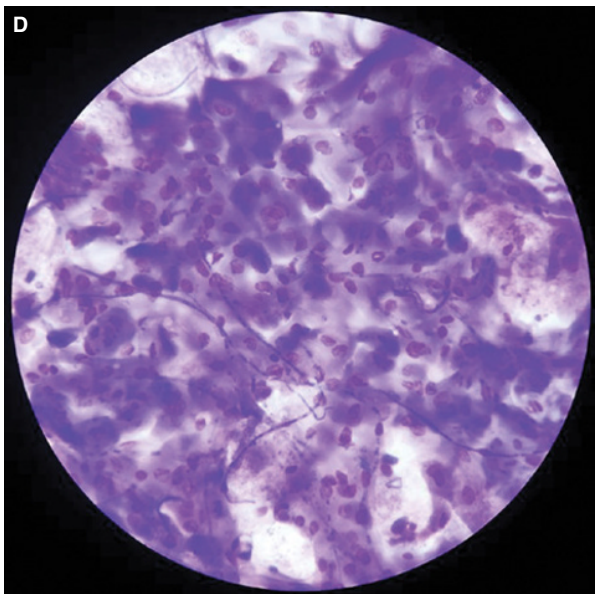
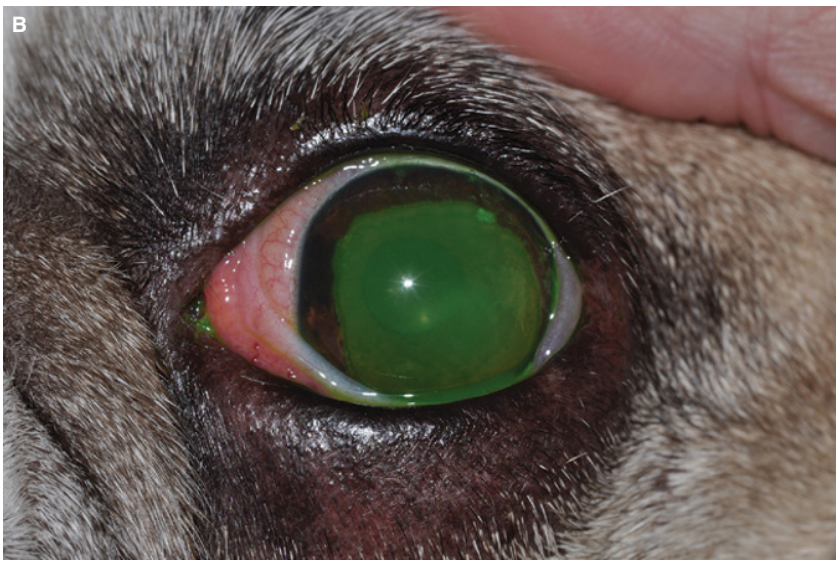
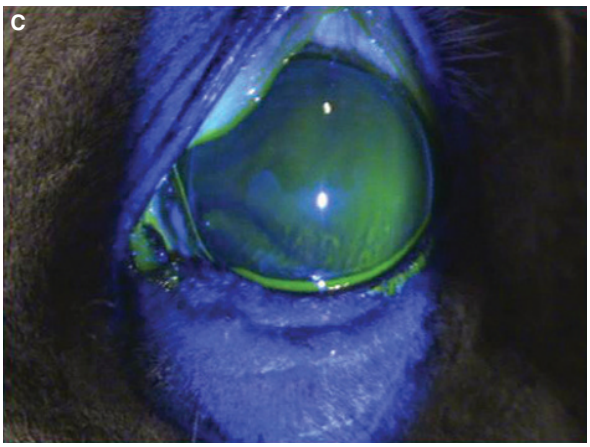


Figure 2.6 (*Continued*) (C) Taking a corneal sample with the dull side of a scalpel blade. (D) A stained example of corneal cytology from a case of fungal keratitis. There are numerous epithelial cells. The linear septate structures are hyphal elements.

Figure 2.7 (A) Topical ophthalmic stains can be applied to the ocular surface directly from the impregnated strip or applied to the eye after dilution with saline in a syringe.





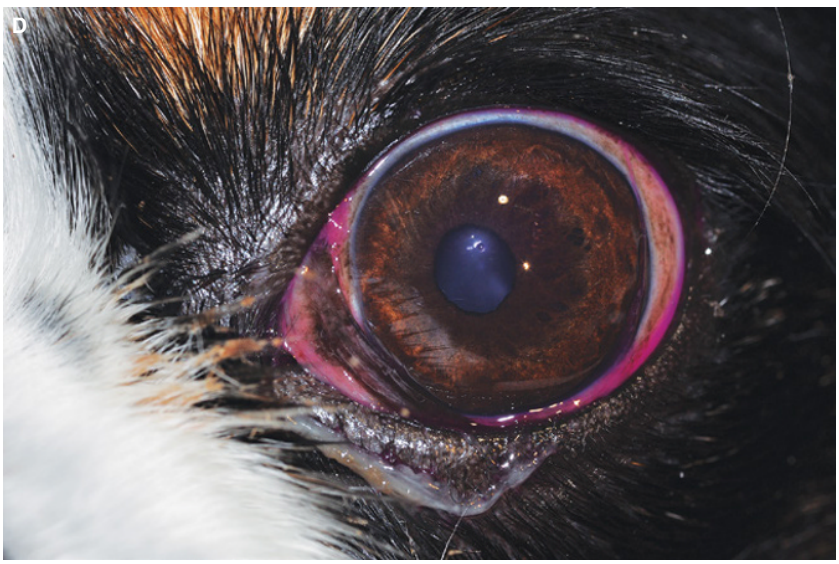


Figure 2.7 (*Continued*) (B) Fluorescein delineating the margins of a superficial corneal ulcer. (C) Fluorescein employed in determining tear film break-up time. (D) Rose Bengal staining a qualitative dry eye.

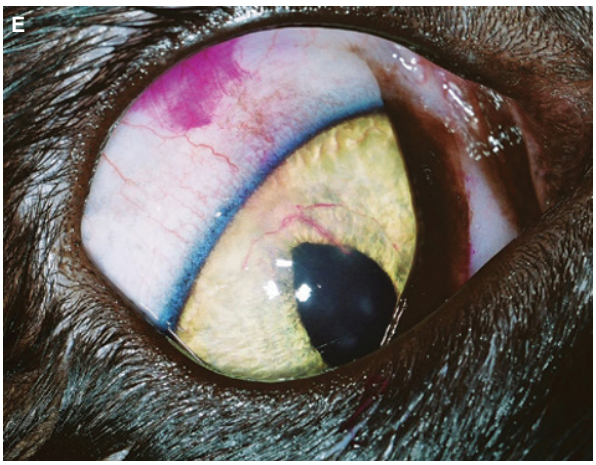
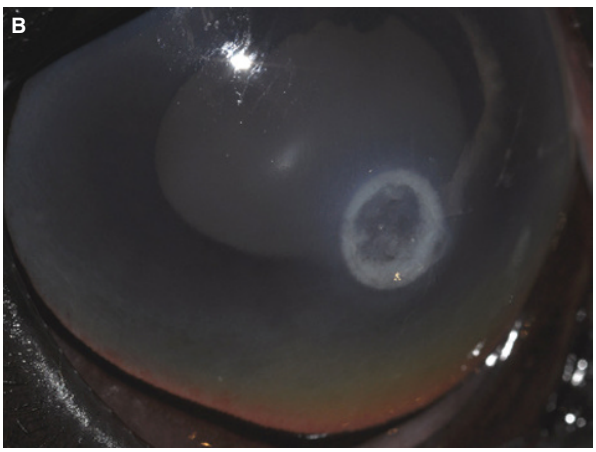


Figure 2.7 (*Continued*) (E) Rose Bengal highlighting a dendritic ulcer in a cat with feline herpesvirus type 1 keratitis.



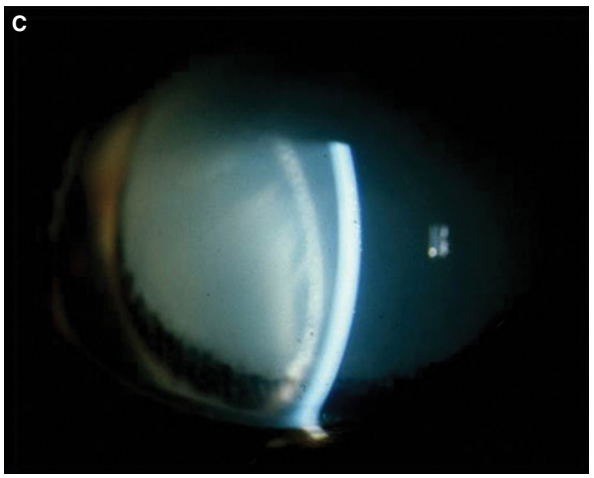


Figure 2.8 (A) Performing slit lamp biomicroscopy. (B) All corneal ulcers should be evaluated for depth or degree of stromal loss. Lesions or deposits in the cornea can be localized by depth as well. This infected corneal ulcer in a horse is approximately 40% depth in the center and the cellular infiltrate in the periphery is in the anterior stroma. (C) Evaluation of the anterior segment should include assessment of the anterior chamber depth. In this eye, the cataractous lens has moved anteriorly at its ventral aspect. Note the narrowing of the space between the cornea and the lens in the ventral anterior chamber. Aqueous flare is visible in this image as well.

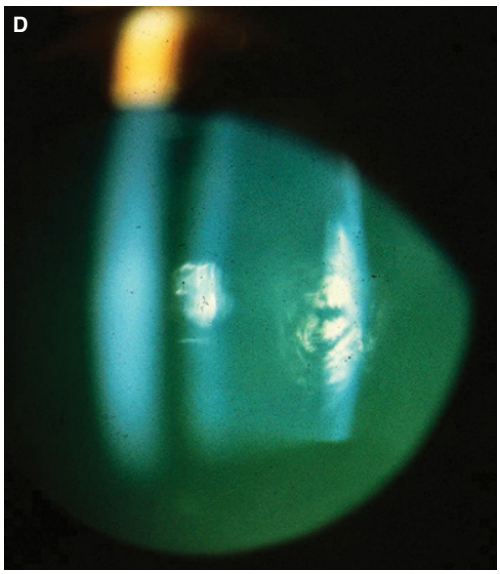
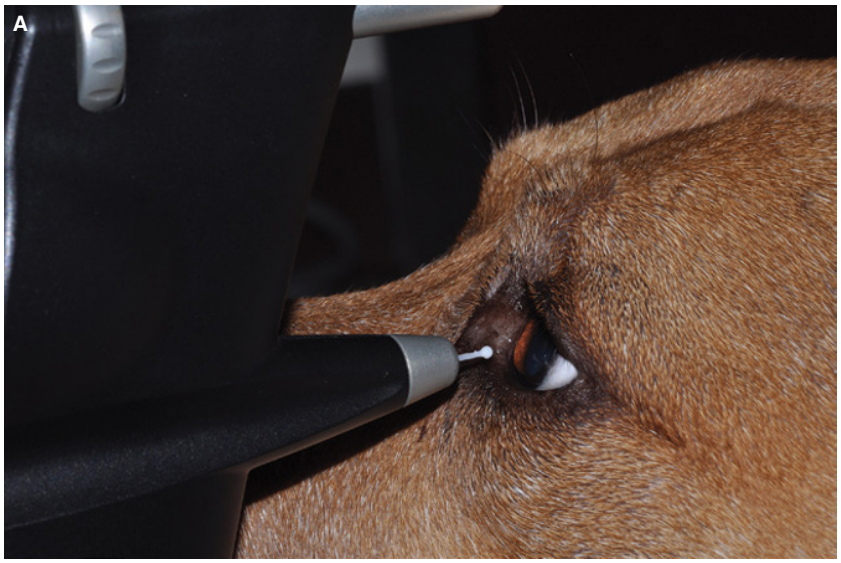


Figure 2.8 (*Continued*) (D) Slit lamp biomicroscopy can help with cataract localization within the lens. In this dog there are two small cataracts, one in the anterior cortex and the other in the posterior aspect of the lens.



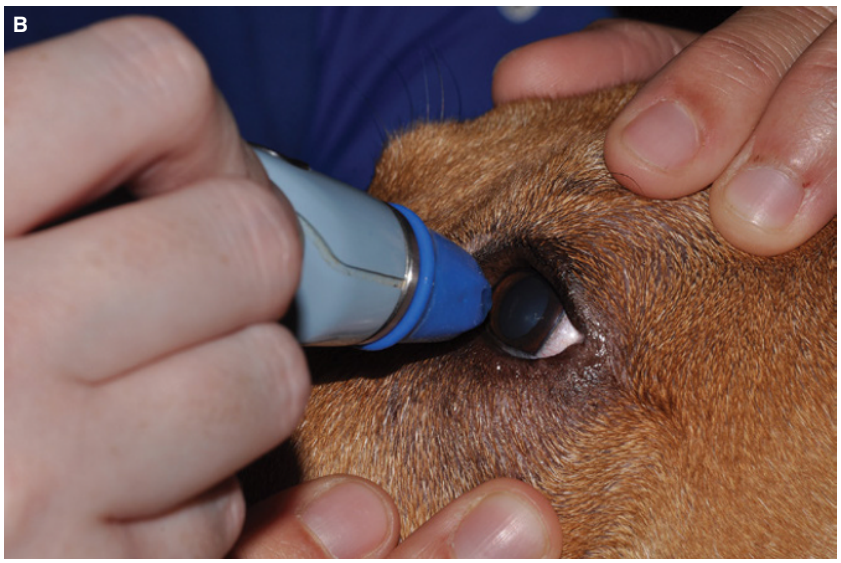


Figure 2.9 (A) Estimating intraocular pressure with a TonoVet rebound tonometer. (B) Estimating intraocular pressure with a TonoPen applanation tonometer.

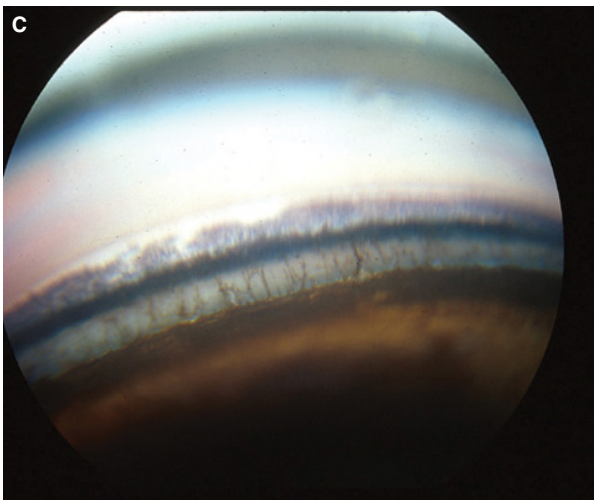


Figure 2.10 (A) A variety of types of goniolenses are available for examination of the iridocorneal angle. (B) Performing gonioscopy with a Franklin goniolens. (C) The view of the normal iridocorneal angle of a dog as seen with gonioscopy.

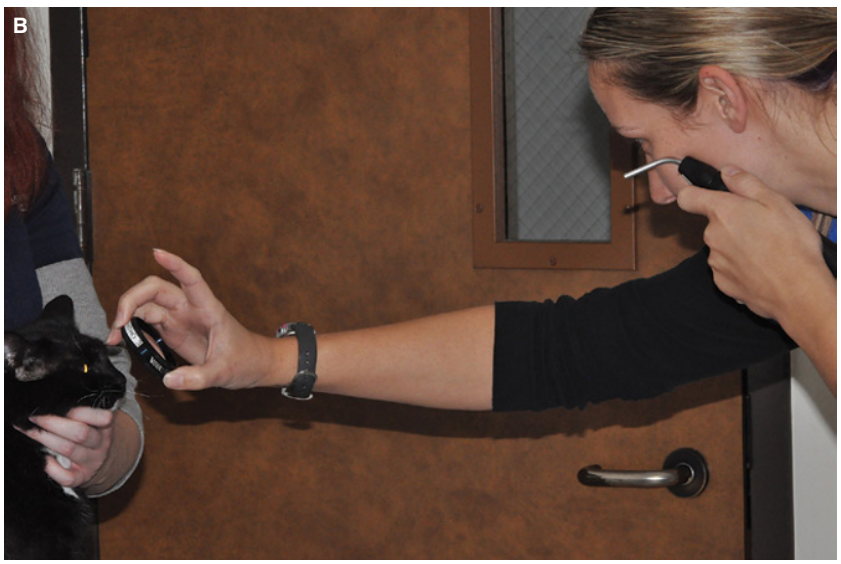


Figure 2.11 (A) Performing direct ophthalmoscopy. (B) Performing monocular indirect ophthalmoscopy. (C) Performing binocular indirect ophthalmoscopy.

Figure 2.11 (*Continued*) (D) The view of the fundus of a dog as seen with indirect ophthalmoscopy. (E) The view of the fundus of a cat as seen with indirect ophthalmoscopy. (F) Performing ophthalmoscopy with the PanRetinal ophthalmoscope, which is a hybrid of direct and indirect ophthalmoscopy.

Figure 2.11 (*Continued*) (G) This canine patient has been appropriately dilated prior to ophthalmoscopy.

horse, punctate keratitis in the dog, and dendritic lesions caused by feline herpesvirus type 1 infection in the cat.

Anterior Segment

The cornea is normally avascular, nonpigmented, nonkeratinized, transparent, smooth, and shiny. The presence of surface irregularities (growth or defects), blood vessels, pigment, or other opacities indicates disease. The anterior chamber is observed for its transparency and its depth. The iris is evaluated for color, consistency, pupillary membrane strands, pupil size, shape, and stability. The pupil can be abnormally dilated with iris atrophy, glaucoma, retinal disease, or optic nerve disease, or it can be abnormally small with Horner's syndrome or anterior uveitis. The lens is evaluated for its position, size, shape, surface irregularities, and its transparency, with both direct illumination and retroillumination (Figure 2.8).

Intraocular Pressure

Before administration of mydriatics, all animals presented for ophthalmic examination should have the IOP evaluated by instrumental tonometry. Tonometry is the indirect measurement or estimation of IOP. It is an essential diagnostic procedure during eye examination in animals, particularly of any eye that is red or painful, has focal or diffuse corneal edema, mydriasis, orbital trauma, a lens luxation, or a history of glaucoma, either of the eye of interest or the fellow eye. Eyes with IOP elevations to 25–40 mmHg may not demonstrate overt signs of glaucoma. Applanation and rebound tonometry are the most common methods employed in veterinary ophthalmology and these techniques are relatively quick and simple and provide crucial information (Figure 2.9).

Gonioscopy

Gonioscopy involves the use of special lenses that mitigate the interference of the corneal curvature which impairs direct visualization of the iridocorneal angle (ICA; Figure 2.10). It is very useful in small animals. Large animals, particularly horses, have areas of their ICA that are visible on direct observation and do not require goniolenses.

Posterior Segment

The vitreous humor is normally a clear and homogenous gel that fills the space between the posterior axial lens capsule, posterior chamber, and ocular fundus. The ocular fundus which posteriorly borders the vitreal cavity includes the optic nerve head (which should be assessed for shape, color, and topography), the retina and its retinal vasculature (evaluate position of retina and number, size, and degree of perfusion of its vessels), and the tapetal (in species with a tapetum) and nontapetal regions (evaluate reflectivity, pigmentation, depigmentation, hemorrhage, exudates). Ophthalmoscopy is a difficult, but very important, procedure for the clinician to master. With diligence and practice, this technique can provide the veterinarian with yet another tool with

which to examine and investigate patients and their problems.

Following adequate mydriasis, the examiner places the direct ophthalmoscope snuggly against his/her brow and identifies the patient's fundic reflex from a distance of approximately 0.5–0.75 m. Once the fundic reflex is identified, the examiner moves toward the patient to a point approximately 2–3 cm from the eye (Figure 2.11). The advantages of direct over indirect ophthalmoscopy include greater magnification, availability of options such as the slit and cobalt blue filters, and ability to alter the dioptric power of the ophthalmoscope. Disadvantages include a small field of view which often results in lesions being missed, particularly in the periphery (which is nearly impossible to visualize with this technique), short working distance between examiner and patient, lack of stereopsis, and greater distortion when the visual axis is not completely transparent.

Indirect ophthalmoscopy allows the clinician a larger field of view of the fundus which can be viewed from a larger and safer working distance from the patient than with direct ophthalmoscopy. The image generated is inverted and reversed (upside down and backwards). To perform the fundic exam following mydriasis, the examiner grasps the patient's muzzle with one hand and stabilizes the head. The other hand is used to hold the eyelids open and to position the lens 2–4 cm in front of the patient's cornea. Successful examination of the ocular fundus requires intimate knowledge of the normal variations within each species.

3

Clinical Signs and Their Interpretations

As clinicians for animal patients, we must gather most of our evidence by what we can observe, feel, smell, and hear. Laboratory and imaging methods then either support our working diagnosis or assist in the development of a list of differential diagnoses which it is hoped will allow us to isolate and ascertain the abnormality, develop strategies for treatment, and provide an accurate prognosis. In this introductory clinical chapter, some of the common clinical signs and observations are summarized, and their pathogenesis and significance presented. In the subsequent chapters additional information of some of these abnormal findings are expanded.

Blepharospasm and Ophthalmic Pain

Animals with ophthalmic diseases can show pain through a number of clinical signs. Blepharospasm is mediated by reflex involving branches of the trigeminal nerve within the cornea and conjunctiva (sensation), and the facial nerve (motor) which innervates the orbicularis oculi muscle, which is responsible for closure of the palpebral fissure. The source of the pain can be within the orbit, eyelids, conjunctiva, cornea, iris, and ciliary body. Pain receptors within the lens, vitreous, and retina-choroid apparently do not exist.

There is also an axonal reflex by which corneal pain is directly transmitted to the anterior uvea, resulting in the release of prostaglandins, histamine, and acetylcholine, a breakdown of the blood–aqueous barrier, iridocyclitis, and aqueous humor flare. This pathway is completely local and does not involve any sensory or motor neural pathway or the brain. Blepharospasm usually signals pain and possible inflammation, therefore the clinician should recognize the need to examine and determine the cause (Figure 3.1). Essential or primary blepharospasm appears rare in animals.

Ocular Discharge

Conjunctival discharges are divided into: serous or catarrhal; mucus (mucoid); and mucopurulent. Often conjunctivitis in animals is secondary to eyelids, nasolacrimal and tear, and corneal diseases. The character of these conjunctival discharges can vary throughout the disease as well as their quantity. Following an insult, the conjunctival flora in secondary conjunctivitis proliferates resulting in mucopurulent exudates that can mask the original insult. As conjunctivitis becomes chronic, secondary thickening, pigmentation, and follicle formation develop (Figure 3.2).

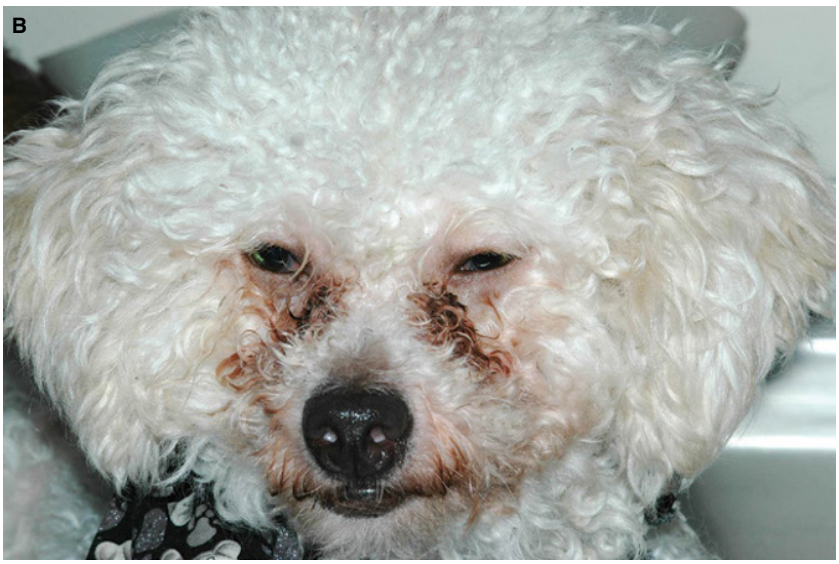
Globe Position

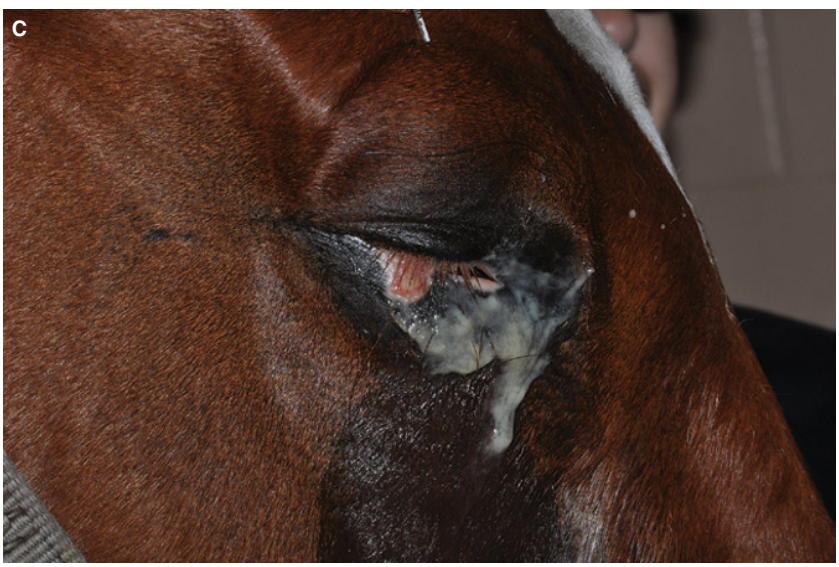
The position of the globe within the orbit varies by species and, especially in the dog, by breed. Changes within the orbit tissues can also influence the position of the globe within the palpebral fissure. Loss of fatty tissues or fibrosis after trauma or orbital surgery can result in reduced orbital tissue (enophthalmia) and restricted globe mobility. In contrast, increase in the orbital mass associated with cellulitis, mucocele formation, and neoplasia can force the globe forward into the palpebral fissure (exophthalmia) and cause strabismus. The direction of the strabismus can often assist in the localization of the mass (Figure 3.3).

Globe Size

Globe size varies widely among the animal species, and for many of the domestic species direct and ultrasonic measurements are available. Globes smaller than normal are termed microphthalmia and those larger than normal are macrophthalmia (also termed megalophthalmia) (Figure 3.4). Corneal and globe measurements

Color Atlas of Veterinary Ophthalmology, Second Edition. Kirk N. Gelatt and Caryn E. Plummer.





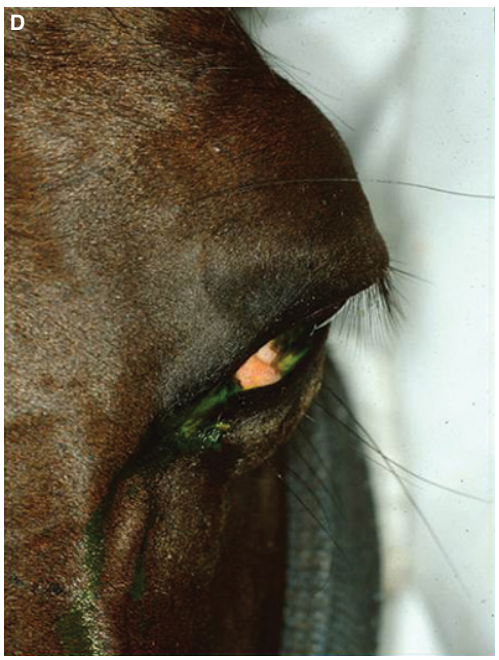


Figure 3.1 (A) Pain/blepharospasm in a cat secondary to entropion. The eyelid outer margin and hair are directly contacting the conjunctival and corneal surfaces. (B) Pain/blepharospasm secondary to distichiasis and a corneal ulcer in a young Bichon Frise. (C) Blepharospasm in a horse with severe anterior uveitis and infected corneal ulcer and blepharitis. There is an abundance of mucoid ocular discharge. (D) Subtle pain in a horse may be demonstrated not by overt blepharospasm but instead by a downward deviation of the cilia (eyelashes).