INTRODUCTION

The examination of the eye and periorcular structures is essential for the complete evaluation of the patient. The diagnostic equipment needed for the basic ophthalmic examination is readily available to the general practitioner. Discussion of the more specialized procedures such as slit lamp biomicroscopy, ultrasonography and electroretinography will also be included to familiarize you with what is available should you need to refer a patient to a veterinary ophthalmologist.

A thorough medical history and complete physical examination should precede a thorough ophthalmic exam. Many diseases of systemic nature may be further elucidated or, in fact, initially diagnosed by their ophthalmic manifestations. Additionally, ophthalmic medical or surgical therapy may be modified by the presence of systemic (cardiac, hepatic or renal) disease.

I. OPHTHALMIC EXAMINATION

A. Vision evaluation

The animal should be observed walking into the examination room with the client, or in its own environment. A blind animal may exhibit high stepping, collision with objects, a stare-like expression, or reluctance to move in a strange environment. The owner's impression that the animal "sees" well at home must be interpreted cautiously. Animals can "memorize" their own environment. The animal is permitted a few minutes to adjust to the room and observed as the history is obtained.

The patient's vision can be further evaluated by noting the response to hand movements, bright lights or to cotton balls tossed into the visual field. The menace response and the visual placement reaction can also be performed to evaluate the vision. In certain circumstances, each eye should be evaluated separately by patching one eye with a bandage or by covering it with one hand.
The vision examination should be performed in normal light, then in dim light. If you can see
the cotton balls or the obstacles of the maze test, the dog or the cat should be able to see them
better than you since their night vision is more developed than ours. Cats generally do not
menace test well, but respond well to bright light stimulation, laser lights, and cotton ball
testing.

B. Ocular examination

Following an evaluation of vision the need for special diagnostic tests is determined. An orderly
sequence of diagnostic tests must be followed based on the special requirements of each test.
Evaluation of the tear film (Schirmer tear test) must be done before the eye is manipulated or
any drugs are instilled. Cultures of the external ocular structures must be done before extensive
cleaning is done and before drugs are instilled. The use of mydriatics is necessary for
examination of the lens and posterior segment, but should not be given prior to measuring the
intraocular pressure (IOP). The intraocular pressure evaluation requires topical anesthetic and
must be recorded before excessive manipulation or before the patient becomes restless and
excited.

1. Periocular examination: Orbit and adnexa

Examinations of anatomic structures should begin with the orbit and other periocular tissues.
Orbits are evaluated for symmetry, eye-orbit relationship, deformities or enlargements. Because
of marked variations in eye position of different breeds, one should be acquainted with the
various breed characteristics. The extremes of variation in eye position can be represented by the
relative enophthalmia of the collie and the exophthalmia of the Pekingese.

The presence or absence of strabismus and nystagmus is noted. Esotropia (crossed-eyes) is
inherited in Siamese cats but in dogs may represent severe intraocular or neurological disease.
Nystagmus occurs frequently in Siamese, apparently not always associated with clinically
detectable vision defects, but in dogs may result from congenital intraocular diseases, or
acquired vestibular or cerebellar diseases.

The eyelid position may be helpful in determining relative globe size. Looking from over the top
of the animal's head helps to estimate globe position. Additional evaluation of the orbit consists
of examination of the mouth (floor of the orbit), palpation of orbital rim, retropulsion of the
globe, and evaluation of nasal patency, if necessary.

Special examinations such as standard skull radiography, orbital angiography, ultrasonography,
CT and MRI, and surgical exploration may be necessary for a thorough evaluation.

*** For the rest of the exam MAGNIFICATION is extremely important to indentify changes or
pathology. Without magnification impacted meibomian glands, ectopic cilia, distichia, corneal
vessels and other subtle changes will be missed. A simple otoscope head with a magnifying lens
and bright light source works great. Other magnifying glasses or headloupes are also available.

2. Eyelids

The eyelids are examined for abnormalities of position, function and structure such as
lagophthalmos, ptosis, trichiasis, ectropion, entropion, blepharitis, lid neoplasms, etc...

The blink reflex should be evaluated. The efferent limb of this reflex requires the integrity of
the facial nerve (CN VII) and the orbicularis oculi muscle. The afferent limb may be a menace (CN II), corneal sensation (CN V) or touch sensation to the periorbital skin (CN V). Rapidity and completeness of the blink should be evaluated.

The lower and upper eyelids should touch the globe. Lower lid-globe contact is important to prevent accumulation of tears and debris. The lower "lacrimal lake" may be grossly distorted by anesthetics and tranquilizers. Cilia or eyelashes occur mainly on the dog's upper lid in three irregular rows. The lower eyelids of dogs and both eyelids of cats are usually void of cilia. The eyelid contours are regular and gently curved, partially exposing the openings of the tarsal or Meibomian glands (gray line). The duct orifices are frequently raised and nonpigmented. Aberrant cilia (distichia) may emerge from the spaces among the Meibomian gland ducts, or the actual duct orifices. Ectopic cilia emerge from within the palpebral conjunctiva of the upper lid and are frequently the same color as the dog's hair coat. They can escape detection without careful examination.

3. The Conjunctiva and the Nictitating Membrane:

The palpebral conjunctiva is examined by manual eversion of the upper and lower eyelids. Excessive lymphoid follicles, increased vascularity, foreign bodies, ectopic cilia, obstructed tarsal glands, hemorrhage, lacerations, abnormal growths and edema (chemosis) may be abnormalities observed. Coloration of the conjunctiva can be used to assess the presence of anemia and icterus. Because the palpebral conjunctiva is transparent, chalazia or impacted Meibomian glands appear as slightly raised yellow masses.

Examination of the palpebral (outer) and bulbar (inner) surfaces of the nictitans is important for diagnosis of several common external ocular conditions. Frequent abnormalities are eversion of the cartilage of the nictitans, prolapse of the gland (cherry eye), foreign bodies, follicular conjunctivitis, enlargement of the secretory gland, foreign bodies, follicular conjunctivitis, and enlargement of the bulbar lymphoid tissue.

4. The Sclera

The sclera should be scrutinized for change in color, abnormal masses, and tears or lacerations. Small vessels in the episclera are usually visible and occasionally a large vortex vein (especially the dorsolateral vein) can be seen. Enlargement and congestion of the episcleral veins occur commonly with glaucoma. This venous enlargement remains even after the glaucoma is "controlled". Hyperemia of the episcleral vessels occurs in association with inflammatory conditions. The "ciliary flush" or limbal hyperemia from iridocyclitis is usually less affected by topical phenylephrine while that associated with the conjunctivitis will usually blanch. The perilimbal scleral vessels are small straight and immovable vs larger mobile and branching conjunctival vessels.

5. The Cornea

Corneal sensitivity (corneal reflex) is tested by a small wisp of cotton gently touched to the cornea. (This must be done prior to topical anesthetic instillation). If the animals sees the stimulation, you will get a false positive.

The cornea is normally transparent, avascular, moist, and unpigmented with a smooth, even contour. It should be carefully examined for loss of transparency (edema or infiltrates), opacity, vascularization, pigmentation, dryness, growths, foreign bodies, lacerations, changes of contour,
and ulceration.

Two types of vascularization occur in the cornea: superficial and deep. Superficial vessels occur in the anterior one-half of the corneal stroma, are usually continuous with visible conjunctival vessels, are "tree-like", and associated with external corneal diseases. Deep vessels appear as small, fine vessels in the corneal stroma that extend from the anterior sclera or deeper limbal vessels (paint brush border), and are associated with intraocular inflammation.

Examination of the cornea is incomplete without utilization of topical ophthalmic stains. Fluorescein is used to demonstrate the presence or absence of corneal ulcers. For topical use, fluorescein impregnated paper strips are preferred to fluorescein solution to insure sterility.

Because the water-soluble fluorescein stains the preocular film, a faint green may occur on the corneal surface.

The corneal epithelium is lipid-selective and prevents any appreciable corneal penetration by fluorescein. In the presence of a corneal epithelial defect, the dye rapidly diffuses into the corneal stroma. An area of fluorescein retention by corneal stroma is indicative of an epithelial defect (a corneal ulcer/erosion).

Rose bengal is a valuable stain in the evaluation of the health of the corneal and conjunctival epithelium. It produces a brilliant red coloration of any dead or degenerating cells, and indicates defects in the mucin layer of the tear film. Rose bengal is retained by the cornea and conjunctiva in early fungal keratitis, keratoconjunctivitis sicca, pigmentary keratitis, exposure keratitis, viral keratitis, and certain other corneal ulcers.

6. The Anterior Chamber and the Iris. ALWAYS EXAMINE THE ANTERIOR CHAMBER!!!!!!

Increased protein in the aqueous humor, when viewed with a focal light source, gives the appearance of a light beam passing through smoke. This is known clinically as "aqueous flare" and its appearance results from the optical Tyndall phenomenon.

Aqueous flare means there is uveitis. When checking for flare also compare the depth of the anterior chamber between the two eyes.

The iris is examined with a focused beam of light and magnification for color, shape, pupil size, surface, and movement. Iridal color in dogs varies from dark brown to blue, and generally 3 "zones" of color are evident (pupillary margin, iris collarette and the iris base). Light brown irides occur in many breeds, such as the Brittany Spaniels, German Short Hair Pointers and other breeds. Iridal heterochromia is not uncommon in white cats, St. Bernards, Great Danes, Beagles, merle Collies, Australian Shepherds, Old English Sheepdogs, Dalmatians and the merle Sheltie. Iris color in cats varies from blue to yellow-green to brown. In acute iritis, the iris may appear congested and swollen with loss of detail, and it may become darker in appearance with chronicity.

7. The Lens

The lens, which is normally a transparent avascular structure, should be examined for opacities (cataracts), position, presence, and size. Focal cataracts should be localized within the various parts of the lens as prognosis and etiology may be suggested by location. Nuclear cataracts are usually stationary while those affecting the equator or posterior cortex are often progressive. By slit lamp biomicroscopy, the canine lens may contain focal imperfections that are not
"cataractous." Early cataract formation, evidenced usually as focal crystallization, vacuoles and water clefts, can be detected long before visual disturbances occur.

Localization of focal cataracts can be performed using the tapetal reflex to highlight the opacity and then observing which direction it moves as the animal's eye moves. For practical purposes, in the dog and cat the center of axis of rotation of the eye is the center of the lens. Thus if a cataract is in front of the lens it will move with the eye movement. If a cataract is in the back of the lens it will move in the opposite direction of the eye movement. Location of a cataract may give clues about its cause i.e. inherited or associated with PRA.

Nuclear sclerosis of the lens begins to develop in dogs around 6 years. Biomicroscopic examinations can detect refractive changes between the lens nucleus and cortex as early as three years of age in dogs. Advanced nuclear sclerosis is clinically evident as a blue zone limited to the lens nucleus that does not impair ophthalmoscopic visualization of the fundus and does not impair vision. This is frequently mistaken for cataract formation in older animals by owners and veterinarians.

8. The Vitreous

The vitreous humor is normally a clear gel. The anterior portion can be examined using focal illumination and some magnification. The posterior aspect of the vitreous is examined by ophthalmoscopy or the slit lamp biomicroscope with added lenses. Frequently seen vitreous abnormalities include vitreous strands, asteroid hyalosis, hemorrhage and infiltration with inflammatory cells. Small remnants of the hyaloid vasculature (seen as white strands) are frequently encountered behind the central posterior lens capsule in the vitreous immediately posterior to the lens. Liquefaction of the vitreous is called syneresis, and opacities that occur in the liquefied state are called "synchysis scintillans". These opacities often rise and fall in the vitreous as the eye moves.

Differentiation of lens and vitreous opacities may pose a problem for the clinician. Localization of intraocular opacities can be achieved by noting direction of movement in relation to the center of the globe, or by slit lamp biomicroscopy. The first procedure is convenient and assumes the center of rotation of the eye is the posterior aspect of the lens nucleus in the dog. Opacities which are anterior will move with eye movement; for example, an anterior cortical cataract will move left when the eye turns left. Opacities posterior to the center of rotation will move in the opposite direction. In the horse the optical center of the eye is the posterior pole of the lens. The stability of the opacity may also help to differentiate lens from vitreous. Lens opacities are fixed and remain stationary when the eye stops moving. Vitreous opacities tend to move slightly or oscillate within the gel vitreous after eye movement ceases.

9. The Fundus

The ocular fundus is examined last and requires direct and/or indirect ophthalmoscopy. Although the fundus can be viewed without drug-induced mydriasis, dilation of the pupil greatly facilitates examination of the complete ocular fundus. The ocular fundus is examined for changes in the normal appearance, detachment of the retina, chorioretinal hypoplasia or dysplasia, vascular patterns, attenuation, congestion, hemorrhage, colobomas, scars, alteration in coloration, changes in pigmentation and foci of inflammation. The optic disc should also be examined for size, shape, color, masses, and pits or colobomas. Swelling and inflammation of the optic disc occurs with optic neuritis, which is characterized by blindness. Myelination of the disk must be differentiated from swelling of the disk.
II. Special Diagnostic Procedures

A. Pupillary light reflexes (PLRs)

The size of the pupils are evaluated and the direct and consensual pupillary light reflexes are tested. This should be done with a bright light in a dimly lit room. The pupillary light reflexes are affected by the psychic state of the animal, room illumination, age, many topical and systemic drugs and the intensity of the light stimulus. Older animals may exhibit slow and incomplete pupillary light reflexes resulting from atrophy of the iris sphincter muscle. This is common in small dogs, especially poodles. The pupillary margin may have an irregular or scalloped appearance. Incomplete iris atrophy may give an irregular pupil shape.

The rapidity of pupillary light response, extent of miosis and ability to maintain miosis to constant light stimulation are evaluated. The consensual pupillary reflex is normally equal to the direct. The pupillary light reflexes require integrity of retinal neural cells, optic nerves, optic chiasm, optic tracts, midbrain (Edinger-Westphal nuclei), parasympathetic fibers via the oculomotor nerve, ciliary ganglia and the iridal sphincter musculature. The reflex is subcortical and should be considered an evaluation of the retina and optic tracts, not of vision.

Drug induced mydriasis is not used indiscriminately. The instillation of mydriatics is avoided in animals with predisposition to, or overt glaucoma, and lens luxation. Young puppies dilate slowly, often incompletely, and may require multiple drops. Mydriasis produced by darkening the room may permit a cursory but not complete examination of the ocular fundus. 1% Tropicamide (Mydriacyl-Alcon Laboratories) provides mydriasis within 15 to 20 minutes in a normal eye.

B. Corneo-conjunctival Cultures and Cytology

Corneo-conjunctival cultures and cytology are helpful in the diagnosis and classification of corneal and conjunctival diseases. The procedures are especially valuable in chronic, severe and non-responsive external ocular conditions. The cultures should be done before any administration of drops, since many of the drugs contain bacteriostatic agents. Topical anesthetics are used prior to the collection of cytologic material.

Sterile swabs are used to collect material for culture. The swab should be moistened. The moistened swab is rubbed over the area to be cultured taking care to avoid skin, hair and other nearby structures. Bacterial identification and disc sensitivity tests aid in the choice of antimicrobial therapy.

To obtain a specimen for cytologic examination topical anesthetic is instilled 2-3 times over a few minutes and the animal's head and muzzle are held firmly by the assistant. To obtain a conjunctival scraping, the lower eyelid is everted and the ventral conjunctival surfaces are vigorously rubbed with a stainless steel or platinum spatula. The collected material is distributed onto glass slides. Ideally, conjunctiva should be scraped vigorously enough to obtain basilar cells without inducing hemorrhage. To obtain a smear of exfoliated cells, a moistened dacron tipped applicator is rubbed along the conjunctival cul-de-sac and then rolled on glass slides. The specimens are stained with new methylene blue, Gram's, Wright's, Giemsa's, or modified Sanf's methods.

C. Nasolacrimal System and Tear Production
The nasolacrimal system and precorneal tear film are evaluated by considering both the secretory and excretory components.

SCHIRMER TEAR TEST

The precorneal tear film is essential in maintaining normal corneal health. Measurement of tear production is an important diagnostic test when deficiency of the lacrimal system is suspected.

The tear-producing system is evaluated qualitatively by examination of the corneal surface for moistness and luster and quantitatively by the Schirmer tear test. The diagnosis of “dry eye” or keratoconjunctivitis sicca (KCS) may be missed if the Schirmer tear test is not routinely used. The Schirmer tear test measures only the aqueous aspects of tears. Currently, aqueous tear production is most commonly measured using the Schirmer tear test.

Schirmer values:

Dog: 21.9 +/- 4.0 mm wetting/minute

Rabbit: 5.3 +/- 2.9 mm wetting/minute

Cat: 20.2 +/- 4.5 mm wetting/minute

Excessive manipulation of the eyelids, topical anesthesia and exposure to other topical and systemic drugs (such as tranquilizers and atropine) are avoided before the test. Increased tear production because of corneal irritation during the test appears to be of little significance in the dog and the cat. The round end of the test paper is bent while still in the envelope and positioned without contamination in the lacrimal lake at the junction of the lateral and middle thirds of the lower eyelid. The animal usually closes its eyelids during the test. After one minute the paper is removed and measured on a millimeter scale on the paper envelope. The STT strip should be left in position for one minute. It is not a linear test, so if you obtain a value of 7 mm/30 seconds this does not mean it will be 14mm/min!!!! If you get an abnormal value <15mm in less than one minute the test should be repeated leaving the strip in for a full minute.

PHENOL RED THREAD (PRT)

The Phenol Red Thread Test is a new, fast and equally accurate method to assess tear production.

In the PRT tear test, the thread is 75 mm long and is impregnated with phenol red, a pH-sensitive indicator. A 3 mm indentation at the end of the thread is inserted into the inferior conjunctival sac for 15 seconds. The alkaline tears turn the pale yellow thread red.

A test time of 15 seconds is required compared to the 5 minutes needed for the STT in humans or the 1 minute in

Anesthesia is not necessary for the PRT tear test because the subject has little or no sensation
from the thread. It is theorized that the minimal sensation and short test time give a more accurate indicator of the volume of residual tears in the inferior conjunctival sac of the eyes.

Mean length of absorption for the PRT tear test in cats is 23.0 mm ± 2.2 mm/15 seconds. The normal range in cats for the PRT tear test is 18.4 to 27.7 mm/15 seconds.

In dogs the mean length of absorption using the PRT tear test is 29.7 to 38.6 mm/15 seconds.

TEAR DRAINAGE

The excretory component of the nasolacrimal system is evaluated by the presence or absence of medial canthal tearing; passage of fluorescein instilled onto the eye; nasolacrimal flush; catheterization of the entire system, and by dacryocystorhinography. The nasolacrimal drainage apparatus consists of two puncta and canaliculi, a poorly developed nasolacrimal sac and the nasolacrimal duct. The oval puncta are situated in the upper and lower medial eyelid margins about 1 to 2 mm in the palpebral conjunctiva. A partial to complete ring of pigment may surround the puncta and facilitates their detection.

Passage of fluorescein from the eye to the external nares is a reasonable test for patency of the nasolacrimal system. A strip of fluorescein is moistened with a few drops of sterile eyewash and touched to the upper bulbar conjunctiva. The dye usually appears at the external nares in 3 to 5 minutes. Both sides should be performed at the same time to compare passage times. Ultraviolet light enhances detection of the dye. Fluorescein passage in brachycephalic dogs and is not reliable as the dye may exit more readily into the nasopharynx. The animal's tongue and saliva should be examined with a UV light in these cases.

The nasolacrimal flush determines patency of the system and the treatment of many of its disorders. The upper punctum is cannulated with a 22-23 g blunt lacrimal needle or 22-24 gauge teflon catheter under topical anesthesia. Tranquilization or general anesthesia is seldom necessary for the dog but often necessary for the cat. A 2 to 3 ml plastic syringe with sterile saline is used to inject the solution through the upper punctum, canaliculus, nasolacrimal sac, lower canaliculus and out the lower punctum. Once this "arc" is established, the lower punctum is compressed digitally and the solution is forced through the nasolacrimal duct and out the external nares. If the dog's head is positioned upward, the dog will swallow or gag on the solution. Excessive pressure should be avoided to minimize the danger of rupturing the N-L system above an obstruction.

D. External Ophthalmic Stains

FLUORESCIN

Examination of the cornea is incomplete without utilization of topical ophthalmic stains. Fluorescein is used to demonstrate the presence or absence of corneal ulcers. For topical use, fluorescein impregnated paper strips are preferred to fluorescein solution to insure sterility.

ROSE BENGAL

Rose bengal is retained by the cornea and conjunctiva in keratoconjunctivitis sicca, early fungal keratitis, pigmentary keratitis, exposure keratitis, viral keratitis, and certain other corneal ulcers.
E. Intraocular Pressure Measurement (Tonometry)

Intraocular pressure (IOP) is estimated digitally, and measured by Schiotz tonometry or applanation tonometry. Subtle elevations in intraocular pressure, repeated measurements of glaucomatous eyes under medical treatment, or after surgical intervention require instrument tonometry.

Applanation tonometers (especially the Tonopen type) are very accurate and easy to use. Applanation tonometers are becoming more common in practices. The Tonopen applanation tonometer has made it much easier to diagnose and treat the animal glaucomas.

IOP is 16.8 ± 4.0 mm Hg in dogs; 20.2 ± 5.5 in cats; and 23.2 ± 6.9 in horses.

F. Ophthalmoscopy

1. Direct Ophthalmoscopy

Direct ophthalmoscopy is used more frequently by practitioners than indirect ophthalmoscopy. However, both techniques have advantages that complement each other when used together. The method is termed "direct" because a condensing lens is not interpositioned between the ophthalmoscope and the patient's eye. The examiner has a direct optical image of the patient's eye. The fundus image is real, upright and approximately about 17 to 19 times magnified in dogs and cats. The fundus area visualized is about 10 degrees or approximately 2 disc diameters.

The direct ophthalmoscope head also offers a range of lenses to enable focusing at various depths within the eye. These lenses are calibrated in diopters. A lens with a power of 1 diopter will focus light from an infinite source (parallel rays) at 1 meter. The higher the diopters, the more converging power the lens possesses. Negative diopters denote diverging lenses. When an emmetropic eye (observer) looks into an emmetropic eye (patient) with an ophthalmoscope the retina of the patient should be in focus at the 0 diopter setting. Minor lens corrections are usually needed to focus on the patient's fundus. Within the eye, a distance of 3 diopters equals 1 mm.

In performing ophthalmoscopy, the patient's body and head are minimally restrained by an assistant. The examiner holds the muzzle and/or lids with one hand and with the other hand holds the ophthalmoscope to make the necessary diopter changes. It is preferred to view the tapetal fundus several inches from the patient and then move to 1 to 2 inches from the patient's eye when the optimum focus is achieved and the animal has adapted to the restraint. The diopter setting is usually started at "0" and adjusted to between +3 to -3 diopters to provide the sharpest image possible. By using more positive lenses the lens can be seen at +8 to +12 diopters and the cornea at +20 diopters.

Direct ophthalmoscopy has certain limitations. Penetration of cloudy or partially crystallized media is limited. Because of magnification, there is a small field of view. Examination of the peripheral fundus is difficult. There may be difficulty in compensating for refractive errors and eye movements. Stereopsis is absent, and depth of focus is limited. The small working distance between examiner and patient may be hazardous to certain species of animals.

The PanOptic ophthalmoscope is available and provides an intermediate level of magnification to the direct and indirect techniques.
2. Indirect ophthalmoscopy

Indirect ophthalmoscopy complements direct ophthalmoscopy. To perform indirect ophthalmoscopy a fairly bright light source is directed into the eye. A condensing lens is interposed between the light source and the eye. Incident light is condensed to illuminate the fundus. The reflected light then is condensed by the same lens to form a virtual, inverted, and reversed image between the lens and the light source.

The advantages of binocular indirect ophthalmoscopy are penetration of cloudy media, large field of view (hence an excellent survey instrument), examination of the peripheral fundus, ease of compensation of refractive errors and eye movements, stereopsis, greater distance between examiner and patient, two to three simultaneous observers and the ability to readily examine the more intractable patients with less hazard to the examiner. The disadvantages include less magnification for studying particular areas, and the need for drug-induced mydriasis.

Indirect ophthalmoscopy can be employed with only a light source and a lens. Several commercial indirect ophthalmoscopes are available. Regardless of the light source used, the power and type of lens used determines the ease and accuracy with which the fundus exam will be conducted.

The indirect ophthalmoscope is adjusted so the light is slightly off center of the examiner's visual field (to reduce glare). The patient's muzzle is held gently and the lens is positioned three to five cm from the cornea and the upper eyelid retracted. The lens is usually held close to the cornea initially to permit observation of the ocular fundus and then moved away from the eye until the image is maximum size. When the hand lens is interposed between the light source and the eye, the fundus is visualized. Image magnification (2X to 4X) is dependent on the dioptric power of the hand lens. The +20 lens is the most versatile. Occasionally, an annoying light reflection occurs and is remedied by slightly tilting the hand lens.

Image magnification is dependent on the dioptric power of the hand lens. The +20 D lens is the most versatile.

H. Ultrasonography

Ultrasonography (as in a ship's sonar system) has become increasingly useful in the diagnosis of intraocular disease in the past few years. High frequency sound waves are directed through the eye. A portion of these sound waves "echo" off tissue interfaces. These echoes are amplified and projected onto an oscilloscope. Echoes from the corneal surfaces, the anterior and posterior lens surfaces, the retina, and any abnormal intraocular material will project an image which aids intraocular diagnosis. This is especially useful when dense corneal opacity or mature cataract obscures the view of the fundus.