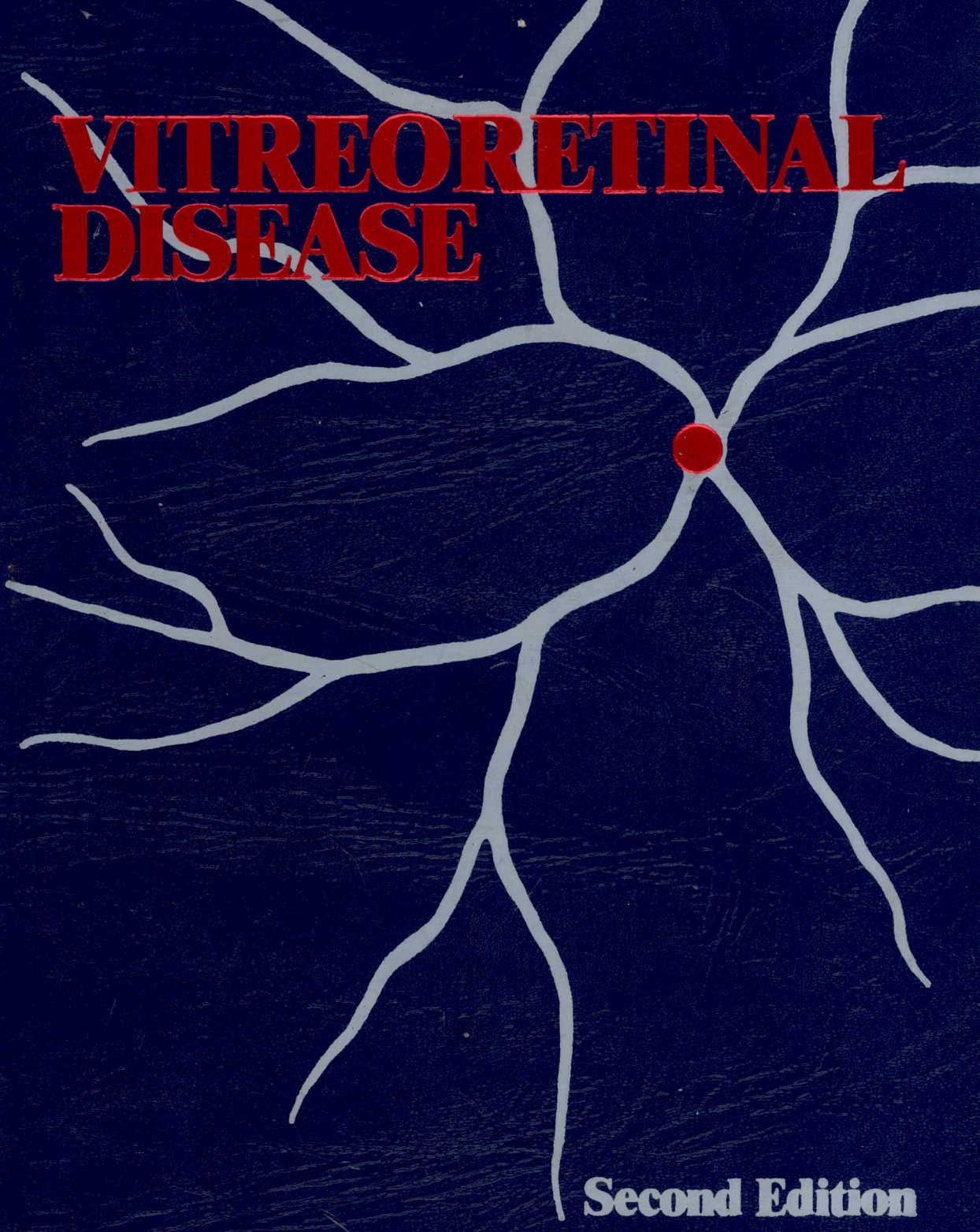
VITREORETINAL DISEASE



Second Edition

Peter H. Morse

SECOND EDITION

Vitreoretinal Disease

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PREFACE TO THE SECOND EDITION

When the first edition of this book was published in 1979, it was virtually the only book of its size broadly covering the field of vitreoretinal disease. Subsequently, several books on the subject have appeared, as well as volumes dealing with the more specialized areas of vitrectomy, macular diseases, retinal vascular disease, and tumors. Nonetheless, this book retains a unique and somewhat unorthodox format to facilitate reasonably rapid, yet thorough, overall comprehension of vitreoretinal diseases.

For the second edition, the book has been rewritten with emphasis at three levels. The first is a progressive plan of history taking and examination, as well as guidelines for therapy; the second is a discussion of basic concepts of vitreoretinal disease; and the third is a cataloguing of specific diseases or syndromes along with symptoms, signs, and treatment.

The presentation is intentionally pragmatic in an attempt to contain a large volume of material within a reasonably sized book. As many techniques as possible are digested and outlined. It is intended as a cohesive introduction for those beginning the study of vitreoretinal disease and as a reference source for the ophthalmologist in practice.

The heroine of this effort has been my secretary, Mildred Jamison, who has expended great energy, mustered supreme patience, and labored innumerable extra hours during its completion.

PETER H. MORSE, M.D.

CONTENTS

1 History and Examination

A detailed history of ocular disease seems elementary and is frequently neglected. Eagerness on the part of the examiner to assess clinical findings is often a deterrent to obtaining a careful history. The history must be complete and chronological but should not be prolix. The history of the present illness is important for the examiner to analyze the patient's problem and in reviewing cases for clinical research. When the history is taken, no assumptions should be made, and information other than that volunteered by the patient should be elicited by pertinent questions.

HISTORY

The history and physical findings are recorded on a form facilitating record review and retrieval of clinical information for storage in a computer (Figs 1–1 and 1–2). Whether obtained by the physician or an assistant, all office records should include the patient's full name, date of examination, history number, date of birth, race, address, zip code, area code, telephone number, occupation, health insurance coverage, and policy numbers. The referring physician's name, specialty, address, and telephone number should also be noted. Capitalizing all letters of the patient's last name makes it more legible and avoids confusion as to which is the surname. The correct spelling of the patient's name should also be confirmed.

For hospitalized patients, additional data such as name of next of kin, religion, name and address of patient's father and mother, mother's maiden name, employer's name, address, telephone number and name, address, and telephone number of a person to notify in case of emergency may be required.

If the patient is married, the name and occupation of the spouse should be confirmed.

In compensation, industrial, or occupational injury cases the name of the firm, address, date, time, circumstances, and type of injury are recorded. In such instances, the examiner should include such preambles as "the patient states that..." to avoid apparent affirmation of statements heard from one viewpoint.

The patient should always be addressed as Mr., Mrs., Ms., Miss, or Dr. The temptation to address a patient by his or her first name, especially during the initial examination, should be avoided. An exception to this may be made with children.

The examiner and his or her assistants should introduce themselves when they meet the patient. This is particularly important when an assistant sees the patient to explain the nature of the examination and elicit preliminary data. Patients should be told that they will be seen by the physician to whom they were referred on completion of the preliminary evaluation.

The concern of the patient should commence the formal inquiry. The history of the present illness includes the length of time that the patient has worn glasses and when they were last changed. It should be determined whether the glasses were prescribed for myopia, hyperopia, astigmatism, for treatment of strabismus including prisms, reading, and whether they are bifocals. Ocular problems in childhood, such as strabismus, "lazy eye," amblyopia, nyctalopia, or injury, are sought. Depending on the sophistication of the patient, several synonyms or phrases may be used during the inquiry to be certain that the questioning is understood. For example, some patients do not understand the term ocular drugs or medication but will readily disclose that they use eye drops.

FORM 48.23-602-1

THE UNIVERSITY OF CHICAGO HOSPITALS AND CLINICS
DEPARTMENT OF OPHTHALMOLOGY

RETINA EXAMINATION RECORD

NAME	Hx #

DATE	BIRTH DATE	AGE	OCCUPATION

RESIDENCE	CHANGE OF ADDRESS

C.C.

H.P.I.

PMHx

DISEASES

OPERATIONS

ALLERGIES OR ANY REACTIONS

Rx

FAM Hx

FIG 1–1.
Form for recording history and clinical findings.

REFRACTIVE ERROR: O.D.

O.S.

VISION: O.D.

O.S.

NEAR O.D.

O.S.

MOTILITY:

SCHIOTZ TENSION: O.D. O.S.

PUPILLARY DILATION: O.D. O.S.

EXTERNAL: O.D. O.S.

SLIT LAMP: O.D. O.S.

CORNEA

A.C.

IRIS

LENS

A.V.

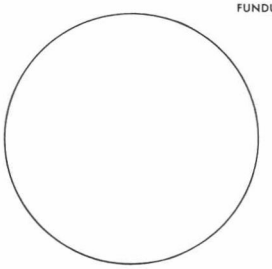
VITREOUS:

GONIOSCOPY O.D. O.S.

FELLOW EYE

O.D.

O.S.



FUNDUS SKETCH DONE _____

_____

SIGNATURE

FIG 1–2.
Reverse side of form.

It is ascertained whether visual acuity was equally good in each eye with or without correction and if the patient had been previously informed by an ophthalmologist that he or she had "20/20 vision." Whether the information came from a general physician, ophthalmologist, or optometrist should be recorded. It is pertinent to ask if eye examinations were periodically sought by the patient, by whom they were given, as well as when the last examination was performed prior to the present difficulty. One must elicit the patient's conception of what he or she was told by the referring physician. If the patient cannot remember, recollection can be stimulated by offering such suggestions as retinal detachment, retinal separation, diabetic retinopathy, hemorrhage, blood clot, holes, tears, pigmentation, scars, or macula or macular degeneration.

When symptoms described by the patient are recorded, sequential progression is important. A few minutes spent listening to the history, with questions by the examiner, is useful before beginning to write details. For example, a patient may forget early symptoms, such as floaters, light flashes, or injury because he or she is more concerned with the recent alarming problem. If a patient describes a loss of vision, it must be ascertained whether it was sudden, gradual, central, sectorial, or total. The symptom of blurred vision is nebulous. Therefore, it is necessary to determine what the patient intimates by this complaint. The duration of the visual impairment and diurnal recovery or worsening should be noted. One must record the date of loss of central vision, because this may affect the prognosis for recovery.

Writing the stages of the history, with the date of occurrence noted first, is a convenient way of recording the present illness. For example, "January 12, 1988 patient states that during early afternoon he noted multiple black spots before the right eye that did not impair visual acuity. These spots largely disappeared by the end of the day. Patient denied ocular trauma, flashes of light, 'curtains' or other defects in the field of vision."

"January 15, 1988, patient states that he saw George Smith, OD, 433 South Street, West Wallace, WY 80001, (307)-482-2121. Patient was examined [note details as recalled by the patient] and was told that he had 20/20 vision in each eye and not to worry. There was no change of glasses or mention of possibility of retinal disease. Patient said that he noted no further problem until July 5, 1988 when upon attempting to read the morning newspaper he noted more black spots in field of vision of right eye and flashes of light. He could not clearly read print with the right eye. These symptoms persisted and upon retiring, he noted pinwheels of light in a temporal location in the right eye in the dark with the eyes closed. July 6, 1988, upon awakening, patient noted a black curtain over lower one half of visual field in the right eye. Patient could not see through this curtain and central vision was gone. He could recognize large objects in upper field of vision but could not read."

A concise, chronological history should be developed in this manner and should include detailed dates, changes in symptoms, visual acuity, and other information given to the patient by previous physicians. The eye in which the symptoms were noted should be recorded. Capital letter abbreviations or acronyms should not be used because they may mean different things or be unknown to physicians who may read the history.

If a visual field defect is detected by the patient, one must question the rapidity of onset, extent, area in which it was first noted, and the direction of progression. Visual field loss is seen by the patient in a location opposite to the area of retinal involvement. A superior retinal separation will produce an inferior visual field defect and a nasal retinal separation a temporal visual field defect. A progression of visual field loss from a certain direction may reveal the area of the incipient disease. The patient should be asked whether the visual field defect is more or less prominent in the morning or afternoon. Floaters must be described as to location, direction of movement, number, size, color, and whether they decreased or increased in number, persisted, or disappeared.

If the patient is teen-aged or younger, the parents must be questioned as well.

Often the patient says that he or she was "not told anything" by the referring physician, which is usually not the case. In the history, the source of the information must be specified as the patient's, physician's, or relative's statement or the referring physician's letter or telephone call. The names of relatives supplying information should be included in the history.

At the end of the history of the present illness, when the immediate concerns of the patient have been covered, further information about the past medical history and family history may be obtained.

Important aspects of the past medical history include premature birth, postnatal oxygen administration, general health, previous commonplace or serious childhood or adult illnesses, physical deformities, current medication (ocular and sys-

temic), previous medical or surgical treatment, injury to the eyes, allergies, and drug sensitivities. If a history of drug sensitivity exists, symptoms of skin rash, urticaria, fever, and difficulty in breathing should be elicited to determine the severity of the reaction. If a patient takes numerous medications, it may be difficult to determine which caused the reaction. Medications such as atropine, neomycin, or penicillin have a frequent prevalence of adverse reaction.

During the past medical history it is helpful to repeat some questions asked in the history of the present illness. This may elicit information that the patient had forgotten during earlier questioning.

The date of and findings on the last physical examination should be noted. It is necessary to question the patient about general health, cardiac and pulmonary disease, hypertension, and diabetes mellitus. If hypertension exists, the known duration, medication, and date and value of the most recent blood pressure measurement are recorded. One must ascertain the duration of diabetes mellitus, associated hypertension, nephropathy or neuropathy, as well as current medication. A telephone call to the patient's physician may be required.

The family history includes blood relatives with ocular disease or blindness, congenital abnormalities, tuberculosis, diabetes mellitus, or hypertension. If the patient has an inherited ocular disease, the genealogy is illustrated in the record. These and other aspects of the history may be amplified, if indicated. As a result of signs detected on examination, more sensitive areas such as drug abuse and sexual habits may have to be explored.

At the end of the history, the examiner must know why the referral was made. A referring physician may desire another opinion or complete operation and care by the specialist. The patient must be asked if he or she was told that an operation would be necessary and if the referring physician wanted the consultant to perform the operation. If there is any doubt, a telephone call to the referring physician will clarify the issue.

EXAMINATION

Before the examination begins, it is helpful to tell the patient and accompanying members of the family approximately how long the examination will take and what steps are involved. The patient and those accompanying him or her should be assured that any concerns or questions will be discussed at the completion of the examination. At each stage an explanation should be given to the patient to ease anxiety. If not told what to expect, a patient may be alarmed by a sudden retraction of the eyelids and the instillation of a drop that irritates the eye.

If the patient is on a gurney or table from which he or she might fall, the patient should not be left alone in an examining room. Many patients have impaired visual acuity or may have temporary reduction in vision caused by the bright lights used for examination and should be guided in the examination room, especially if the background illumination is reduced. Frequently, there are table legs, footstools, or other obstacles over which the patient might fall. Attention to these details is important.

If both patient and examiner are comfortable, awkward or tiring positions that may provoke haste and inaccuracy will be avoided. The examination should proceed as swiftly as possible and yet be thorough and systematic.

Following the history, a complete ophthalmologic examination is performed on both eyes of every new patient. After each step of the examination, the examiner should write or dictate the findings to preclude omissions.

Visual Acuity

Measurement of visual acuity should always be the first step in an ocular examination. The patient's spectacle lenses should be neutralized and the powers recorded. The fellow eye should be completely covered during the testing, and measurement should be taken for both distance and near vision. A pinhole is used to obtain an estimate of the potential acuity. Refraction often may be necessary to determine the best corrected visual acuity. After intracapsular cataract extraction, especially unilateral, many patients have not been refracted and therefore require a +10, +11, or +12 sphere, often combined with a 2-mm pinhole, to allow an accurate assessment of visual acuity. A frequent oversight is to measure the visual acuity of an aphakic or pseudophakic patient when he or she is wearing the preoperative spectacle correction. Vision should first be tested in the eye with reduced visual acuity. If visual acuity is reduced to less than 20/400 (6/150), the patient should walk toward the illuminated chart. If the 20/400 letter is seen at 5 ft, the visual acuity is recorded as 5/400. For patients who are handicapped, portable charts may be brought closer to the patient. Metric equivalents are also used (Table 1–1). A convenient way of combining the refractive error and visual acuity is right eye (OD) −3.50,

TABLE 1–1.
Distance Vision

Metric	Ft	Decimal
6/5	20/15	1.2
6/6	20/20	1.0
6/7.5	20/25	0.8
6/9	20/30	0.7 (0.66)
6/12	20/40	0.5
6/15	20/50	0.4
6/18	20/60	0.33
6/21	20/70	0.3
6/24	20/80	0.25
6/30	20/100	0.2
6/60	20/200	0.1
6/150	20/400	0.05

Counting fingers (CF), hand movements (HM), and shadow movements (SM) are recorded in rough metric equivalents or in feet (1m = 39.37 U.S. in). NLP or NPL = no perception of light.

+0.75, × 90 = 20/200 (6/60); left eye (OS) −3.75, +0.25 × 90 = 20/40 (6/12). A 2-mm pinhole equals no change. For near vision, OD add +2.50 = no Jaeger type at 14 in.; OS add +2.50 = Jaeger 1 at 14 in. The measurement of near vision includes the distance at which the patient holds the type when reading. Commonly used notations are Jaeger or point type (Table 1–2).

External Examination

Observations on external examination include craniofacial abnormalities, hemangiomas, pigmentation, or changes of skin texture. The skin on the lateral surface of the patient's neck may reveal pseudoxanthoma elasticum. Changes in pigment are sought in the lashes, brows, and hair. In patients with congenital anomalies, an examination of the ears, mouth and palate, extremities, and general habitus is needed. Signs of recent injuries or scars should be noted. Comparative eye size as well as proptosis or exophthalmos may be observed.

Examination of the lids, lashes, lacrimal system, and conjunctiva, as well as the sclera, is performed. When the sclera is examined, the patient is asked to look down while the examiner retracts the upper lid and to look up while the lower lid is retracted. The patient is also asked to look medially and laterally with both lids retracted.

The cornea is inspected and corneal sensitivity may be evaluated especially in diabetic patients. The direct and consensual pupillary reaction to light and accommodation is tested. The color of the irides should be recorded and transillumination or other abnormalities noted.

Muscle Balance

Extraocular movements, ductions, versions, muscle balance, alternate cover, cover-uncover tests, prism measurement of esotropia or exotropia, and a complete strabismus examination are done if indicated.

Slit Lamp Examination

Slit lamp examination of lids, lashes, conjunctiva, sclera, cornea, anterior chamber, and iris, with a special search for rubeosis iridis using the highest magnification (25×), is made prior to instillation of drops. Phenylephrine (Neo-Synephrine) 2.5% or 10% constricts the conjunctival vessels, and topical anesthetics may cloud the corneal epithelium. Dilation of the pupils with sympathomimetic and parasympatholytic agents may obscure iris disease. In patients with anterior or posterior chamber intraocular lenses, the position of the lens is evaluated. Slit lamp examination is repeated after dilation of the pupils with special attention to the anterior chamber, lens, and anterior vitreous. An evaluation of the transparency of the posterior capsule and lens optic in patients with posterior chamber intraocular lenses is important. Pigment in the anterior chamber after dilation of the pupil may indicate diabetes mellitus. After dilation of the pupils, many patients have a slight flare in the anterior chamber, which does not indicate disease.

TABLE 1–2.
Near Vision Test Charts*

Jaeger	Point
14	24
12	18
10	14
8	12
7	10
6	9
5	8
3	6
2	5
1	4
1+	3

*Distance in centimeters or inches at which the test types were read with or without correction should always be recorded.

Vitreous mobility or flow time is measured by having the patient look quickly down and then fixate the eyes straight ahead. Normal movement of the anterior vitreous fibrils usually lasts 20 to 30 seconds. A medium-sized slit aperture is used to evaluate vitreous turbidity after the pupil is dilated.

The presence of golden brown melanin pigment in the anterior vitreous suggests the possibility of a retinal tear or retinal separation. Occasionally erythrocytes may be seen. The importance of these findings may be negated by a history of intraocular surgery, cryotherapy, severe inflammation, or ocular trauma. Some patients with retinitis pigmentosa have white blood cells (WBCs) in the vitreous.

The ocular fundus may be scanned using noncontact or contact lenses. Commonly used noncontact fundus lenses are the Hruby, El Bayadi-Kajiura, and Volk or Nikon 60- or 90-diopter (D). The Hruby and El Bayadi lenses are mounted on the slit lamp. The Hruby, positioned about 1 cm from the cornea, gives a virtual erect image and small field view. The El Bayadi lens is placed 1 to 2 cm from the cornea and provides a real inverted image. The Volk or Nikon 60- or 90-D lens is hand held approximately 1 cm from the cornea. A real inverted image with a wide-angle view is obtained. Usually contact lens examination is performed after ophthalmoscopy because the viscous contact lens solution will impair visualization of the fundus even after irrigation of the eyes with balanced salt solution. A less viscous solution, such as methylcellulose (Tearisol), will allow easier visualization of the retina after the contact lens examination. However, air bubbles between the contact lens and corneal epithelium occur more frequently with less viscous solutions.

The location, extent, and degree of crystalline lens opacities should be recorded. For example, the gradings 2+ nuclear sclerosis, 3+ cortical opacity, 1+ posterior subcapsular cataract, 1+ peripheral cortical spoking are subjective but help the individual physician to make comparisons. Retroillumination of the lens helps to evaluate these changes with respect to opacification of the media.

A common error is to use the slit lamp at a higher magnification than necessary. Better evaluations are obtained with the 10× oculars and the fixed objective lever at 1×. Occasionally, areas need scrutiny with a higher magnification of 16× obtained by placing the fixed objective lever at 1.6× or 25× by introducing the 16× oculars with the fixed objective lever at 1.6×. Having the patient fixate the fellow eye on a light attached to the slit lamp is sometimes helpful in stabilizing the eyes.

Intraocular Pressure

Measurement of intraocular pressure by applanation is attempted in every patient. The Schiøtz tonometer may be used for screening. The pneumotonometer may be used for anxious patients, children, patients with irregular corneal surfaces, or those who cannot stabilize their eye movements. When slit lamp examination or gonioscopy reveals a shallow anterior chamber, a short-acting mydriatic agent should be used and the intraocular pressure measured after dilation. The risk of precipitating angle-closure glaucoma after pupillary dilation, although rare, is possible.

If a patient has open angle glaucoma and has been told not to take medication that constricts the pupils for 24 or more hours prior to examination to facilitate pupillary dilation, acetazolamide (Diamox) may be given orally during this period and at the time of instillation of mydriatics. A softer eye facilitates scleral indentation. A patient taking medication for glaucoma should have the type of medication, the time at which it was last taken, as well as the time of the measurement of intraocular pressure recorded. Severe pupillary constriction after treatment with echothiophate (Phospholine Iodide) may sometimes be reversed by subconjunctival injection of pralidoxime (Protopam). This is not effective after chronic use of echothiophate. The use of β-adrenergic blocking agents in the treatment of glaucoma has markedly reduced the problems encountered with medications that constrict the pupil.

Gonioscopy

Ideally, gonioscopy should be performed before pupillary dilation using as nonviscous a solution as possible. Some gonioscopy lenses require no solution. Gonioscopy may be repeated after dilation to see whether the width of the angle changes appreciably. Attention should be paid to angle recession, extent, amount and type of pigmentation in the angle, presence of rubeosis iridis, inflammatory debris, foreign bodies, tumors, position of the haptics of anterior chamber intraocular lenses, and peripheral anterior synechiae.

Gonioscopic findings should be recorded on concentric circles. Abnormalities may be drawn and labeled according to the hours of the clock.

Dilation of the Pupils

For an examination requiring dilation of the pupils, patients are told to bring sunglasses with them or they are given a pair of disposable sun filters to relieve temporary glare, or photophobia. A drop of topical anesthetic in each eye relieves the repeated sting caused by multiple instillations of drops used to dilate the pupils and has a minimal risk of causing corneal epithelial edema. Both eyes are dilated using phenylephrine 2.5% or 10% and either tropicamide (Mydriacyl) 1%, homatropine 5%, scopolamine 0.25%, or cyclopentolate (Cyclogyl) 1% two or three times at 5-minute intervals. Following instillation of the drops, 15 to 30 minutes are usually required for full dilation. In some patients a second set of drops is needed. In hypertensive patients, caution should be exercised in using phenylephrine 10%, which may elevate the blood pressure and has reportedly caused cerebrovascular accidents and myocardial infarction. However, phenylephrine 2.5% is not without risk. Sympathomimetic medication stimulating Müller's muscle may create a retraction of the upper lid, giving the appearance of proptosis or exophthalmos in some patients. Cyclopentolate sometimes causes psychotic reactions, behavioral disturbances, ataxia, incoherent speech, restlessness, hallucination, and disorientation, especially with the 2% concentration. Tropicamide 1% has been reported to cause psychotic reactions, behavioral disturbances, and cardiorespiratory collapse, especially in children. Some examiners prefer to have patients keep both eyes closed at all times except when they are undergoing examination.

Direct Ophthalmoscopy

Before direct ophthalmoscopy it is often helpful to scan the fundus with the indirect ophthalmoscope. Ophthalmoscopy is usually performed in a dimly illuminated or dark room. Direct ophthalmoscopy gives a magnification of 15× and may be used to visualize greater detail of the disc, macula, and posterior pole, as well as to assess the clarity of the media. The field of view obtained with the direct ophthalmoscope covers an area of about 10 degrees, or approximately 1.25 disc diameters, in an emmetropic eye. The monocular image is erect. Many patients tend to tilt the head backward, making ophthalmoscopy difficult. They should be instructed to sit upright looking straight ahead. Patients with high myopia may be more easily examined while wearing their spectacles or contact lenses, thereby avoiding the image magnification induced by myopia. The direct ophthalmoscopic examination should begin with the examiner standing about 1 ft in front of the patient with the instrument diopter setting at +10 D. A clear red reflex should be seen, which may be impaired to a variable extent by opacities within the ocular media. Following extracapsular cataract extraction and a posterior chamber intraocular lens, the posterior capsule may be wrinkled or opacified, complicating visualization of the fundus. The pupils may not dilate well. The examiner should move slowly toward the patient, reducing the diopter setting stepwise toward zero and assessing opacities in the media as his or her focus approaches the retina. A hyaloid ring in the vitreous, as well as other opacities, may be seen. The retinoscope may also be used to evaluate opacities in the media. Examination with the direct ophthalmoscope assesses the clarity of the media of patients requiring photocoagulation. The greater penetration with the light of the indirect ophthalmoscope gives one a false impression of what may be visualized.

Despite the limitation of field size, depth of field, and greater distortion because of higher magnification, the direct ophthalmoscope often makes it possible to examine the ocular fundus through a pupil that does not dilate well. The distortion with high magnification is of less concern in the posterior pole than in the periphery of the fundus. Early neovascularization of the disc in diabetic patients may be missed with less magnification. Both direct and indirect illumination may be cast on the fundus lesions by manipulating the direct ophthalmoscope. Direct ophthalmoscopy is more difficult with patient eye movement, high spherical or astigmatic refractive errors, and hazy media. It is also cumbersome to attempt scleral indentation during direct ophthalmoscopy. However, the patient is usually more comfortable with illumination that is less intense than that of the indirect ophthalmoscope.

Indirect Ophthalmoscopy

All patients should be examined with the indirect ophthalmoscope and scleral indentation. The refractive error of the examiner may be corrected by incorporation of the appropriate lenses in the oculars of the indirect ophthalmoscope. Indirect ophthalmoscopes are also supplied with filters such as cobalt blue or red free, which may be rotated in and out of the field. Most indirect ophthalmoscopes are equipped with teaching mirrors that

enable the examiner and observer to simultaneously view the ocular fundus. Teaching mirrors decrease the amount of available illumination.

The condensing lenses, ophthalmoscope mirrors, and both the posterior and anterior surfaces of the oculars must be clean. Fingers must not touch the condensing lens surface, because a fingerprint on the lens will markedly impair visualization.

Comfortable adjustment of the headbands of the indirect ophthalmoscope is important. The stabilization of the instrument is effected primarily by the band across the top of the examiner's head rather than by unnecessary constriction of the circumferential headband. The eyepieces and light should be aligned on a target at arm's length (Fig 1–3). Using the back of one's hand as a target is convenient. The examiner first closes one eye and then the other, centering the light field of each eye on the back of the hand. When the light field and eyepieces have been aligned, the light is shifted slightly to the upper field by manipulation of the mirror prior to examination of the patient.

Indirect ophthalmoscopy gives the widest view and stereopsis for a survey of the fundus. Less difficulty in visualizing the fundus is encountered with patient eye movement during indirect ophthalmoscopy. Because of the relatively low magnification, distortion is reduced. It facilitates examination of the peripheral fundus. There is good penetration of unclear media with more intense illumination. However, when high intensities of illumination are used, the patient may feel marked discomfort. Most patients reflexly squeeze the eyelids when bright light enters the eye. Patients with cataracts are more sensitive to glare. On rare occasions patients experience a reflex sneezing on exposure to bright light.

The examination is best begun at lower transformer voltages, such as 4 or 5, and increased as the patient adapts to the light. Voltage may be increased when viewing the fundus periphery because there is less sensitivity to light.

A binocular stereoscopic field of view is obtained that is somewhat limited by smaller pupil size. This problem is partially overcome by the use of a small pupil ophthalmoscope and a small diameter 30-D condensing lens. The working distance between patient and examiner is at arm's length, and a tendency to move closer to the patient, if there is initial difficulty, should be resisted. The image seen by the examiner is inverted and reversed, but this is compensated for by practice and with proper orientation of the fundus drawing chart (see Chapter 2).

The 30-D condensing lens gives about 2× magnification and is especially useful with smaller pupil size, with highly elevated retinal separations, with choroidal (combined) detachments, and for patients, especially infants and children, who cannot control eye movement. The 20-D condensing lens covers about 37 degrees of the fundus and gives a magnification of about 3.5×. The 14-D condensing lens magnifies about 4×. With a decrease in the number of diopters of power and greater magnification, depth of field is lost.

The examiner holds the condensing lens with the thumb and first one or two fingers of one hand. The remaining fingers may rest gently on the patient's face to help stabilize the lens. The middle or ring finger may be used to gently retract the patient's lids during examination. The other hand of the examiner may also be used to retract the lids. The patient's lids should be spread only enough to expose the diameter of the dilated pupil. Excessive separation of the lids lifts the lid away from the globe, and when air contacts the palpebral conjunctiva, the patient experiences discomfort and tends to squeeze the lids closed. During indirect ophthalmoscopy, a slight tilting of the condensing lens with the lens plane kept perpendicular to the examiner's visual axis eliminates troublesome light reflexes. The convex surface of the lens is held toward the examiner. When one is learning indirect

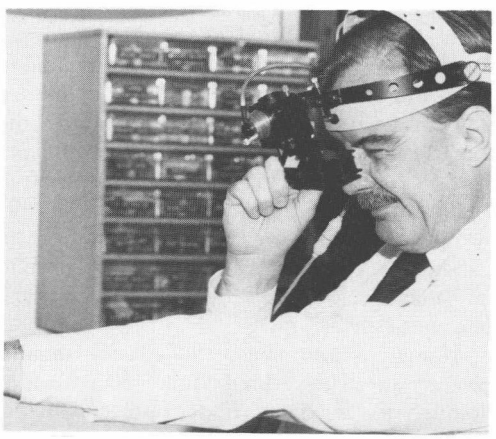


FIG 1–3.
Examiner aligning the light of the indirect ophthalmoscope. The light is positioned on the back of the hand at arm's length. The left eye is closed for alignment of the right eye and the right eye closed for alignment of the left eye.

ophthalmoscopy, the condensing lens should be placed close to the patient's eye and slowly withdrawn until a view of the fundus is seen filling the field of the lens. To obtain a full field of view during ophthalmoscopy, one must hold the 30-D lens closer to the eye than the 20-D lens and the 14-D lens further away than the 20-D lens.

Indirect ophthalmoscopy is often begun with the patient seated, because this provides the greatest gravitational effect on a superior retinal separation. The examiner stands or sits facing the patient with the patient holding the drawing chart in a clipboard on his or her lap. The lower right corner of the drawing chart, marked imago inverta (inverted image), is positioned closest to the patient's body on his or her right side. This places the 12 o'clock meridian of the drawing paper closest to the examiner so that when the patient looks upward, the examiner draws exactly what he or she sees on the portion of the fundus chart closest to him or her. The patient looks in each direction of gaze, and the findings are recorded on the appropriate segment of the chart (see Chapter 2).

If the patient has difficulty fixating in the various directions of gaze, the examiner should make certain that both of the patient's eyes are open. If the patient closes the fellow eye, ocular movements cannot be controlled. The patient's hand may be placed in various positions, and the examiner may direct the patient to look at his or her own hand or in the direction of his or her shoulder, knee, or feet. At other times the patient may find it easier to direct the gaze of the fellow eye at more distant objects such as the examiner's shoulder. A lid speculum is rarely necessary. A patient may be told to look in the direction of gaze indicated by the examiner as he or she taps on various parts of the patient's face. This is useful for patients with hearing loss or a language barrier. An initial communication with instructions may eliminate difficulty during examination. For example, instructions in an audible voice or sign language may be given to deaf patients or by an interpreter to patients with a language barrier.

Young children may be difficult to examine. However, distraction with a bottle for an infant or a lollipop for a young child, coupled with decreased illumination of the indirect ophthalmoscope, often allows an adequate view of the fundus. The examination of children, particularly premature infants, should be slow and gentle. Abrupt movement may frighten a child. If the lids cannot be adequately separated by the examiner's fingers, a pediatric lid speculum or small Desmarres retractors, one for each lid, held by an assistant may be used. If scleral depression is required in premature infants or small children, after 1 drop of topical anesthetic has been instilled, a bent paper clip may be used. If a complete examination is extremely uncomfortable for the patient and the examiner is certain that there is ocular disease requiring further evaluation and surgery, the examination and drawing may be completed under local or general anesthesia.

The patient is examined in the supine position, usually on an examining table, gurney, or motorized reclining chair. It is necessary to ensure the comfort of both patient and examiner. A small pillow beneath the patient's head is often helpful. The examiner must remain flexible and be prepared to move around the patient and assume different positions to obtain the best possible view of the ocular fundus. If the examining table cannot be raised or lowered, a small footstool on which to stand or a stool on which to sit may be of aid. The patient is asked to look straight up at the ceiling. A fixation target on the ceiling is helpful. When patients are in the supine position and are told to look "straight ahead," they often look toward their feet.

The examiner begins standing beside the patient on the side of the eye being examined and observes the posterior pole (Fig 1–4). A sign indicating moderate to high myopia is seen looking at the dilated pupil with the eye in the primary position of gaze using the indirect ophthalmoscope without the condensing lens. A lighter colored yellow-orange reflex, retinal blood vessels, and disc may be indistinctly visualized.

The condensing lens is tilted least when the posterior pole is examined. The configuration of the retinal detachment should be compared in the various positions of gaze, often with the patient in both seated and supine positions to ascertain the presence of shifting fluid. Shifting fluid causes marked changes in the configuration and extent of a retinal separation. Often an area of retina that appears attached may dramatically elevate. When scanning the fundus with the indirect ophthalmoscope, the examiner rocks his or her body slowly back and forth or from side to side holding the lens surface perpendicular to his or her visual axis. The lens will move with the examiner's body, enabling him or her to view the area between the posterior pole and the equator, which may be missed if the field is abruptly shifted from the posterior pole to the periphery. This should be done while one is moving around the patient in all positions. The patient's pupil, center of the condens-

FIG 1–4.
Examination is begun standing on the side of the eye being examined with the patient looking at the ceiling. Note position of the clipboard, pencils, and patient's hands steadying the board.

ing lens, and the examiner's pupil must be maintained on a straight line. The patient's pupil becomes the fulcrum as the examiner shifts position to view more peripheral areas of the retina. The course of the retinal vessels should be stereoscopically followed to detect elevation. On occasion vitreous debris in the periphery may be mistaken for a retinal separation, but the observation that the retinal vessels extend beneath this opacity as opposed to being elevated obviates confusion. Vitreous opacities and membranes, especially in relation to the retina, should be evaluated stereoscopically as well.

The patient is directed to look in eight different directions, straight up, up and left, directly left, down and left, directly down, down and right, directly right, and up and right. While the examiner is drawing observations, it is more comfortable for the patient to close his or her eyes. This helps maintain corneal epithelial hydration and clarity. The patient frequently experiences a burning sensation if both eyes are open for prolonged periods during ophthalmoscopy. With the patient fixing his or her eyes in the various positions of gaze, the examiner moves around the patient for 360 degrees, keeping his or her body flexible and looking from the side opposite the patient's direction of gaze (Figs 1–5 and 1–6). For example, if the right eye is being examined and the patient is looking up and to the right toward 10 o'clock, the examiner is positioned on the patient's left side at 4 o'clock. When examining the fundus periphery, the examiner must remember to tilt the condensing lens sufficiently to avoid light reflections while keeping the lens surface perpendicular to his or her visual

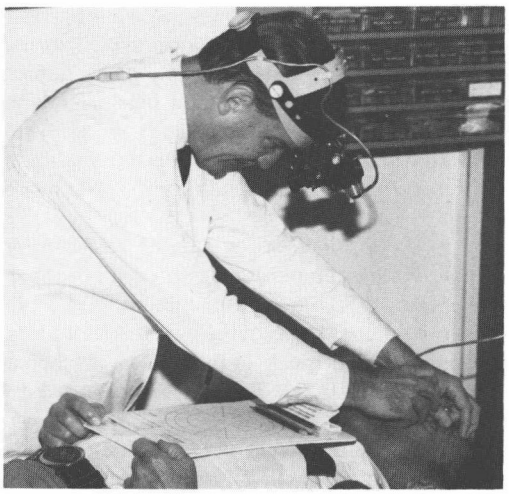


FIG 1–5.
Examiner looking at the superior fundus of the patient's left eye. The thumb of the hand not holding the condensing lens elevates the patient's upper lid.

FIG 1–6.
Examiner looking at the inferior portion of the fundus of the patient's left eye. The index finger of the hand not holding the condensing lens is used to retract the patient's lower lid.

axis. On occasion, a fundus lesion may be better seen from a position opposite to the conventional one. The periphery of the fundus may be difficult to visualize, especially when the patient looks in extreme positions of gaze, rendering the pupillary opening oblique and narrow. This is a particular problem when the patient looks inferiorly. If the patient does not look as far down, the examiner's view will improve greatly.

Patients should keep their neck relaxed during ophthalmoscopy because the view of the fundus may be enhanced if they roll their head slightly to one side or the other. Many patients tilt the head backward with the chin elevated, which makes them uncomfortable and the examiner's task more difficult.

Special positions are sometimes useful. For example, if the examiner is concerned about a shallow superior detachment with shifting fluid, a pillow may be placed beneath the patient's shoulders, hyperextending the neck, or the patient's neck may be briefly hyperextended over the edge of the examining table, making the detachment more obvious. This maneuver may also be used to detect mobility of the flaps of giant retinal tears. Another position used to evaluate shifting fluid or the mobility of the flap of a giant retinal tear is with the patient extending his head over the edge of the examining table in a prone position. The examiner observes from a position beneath the patient. Brisk, voluntary jerks of the patient's head in various directions may also give a clue to the flexibility and the mobility of a giant tear flap. However, care must be taken using this technique to avoid further tearing of the retina. A safer but less rapid evaluation may be obtained by preoperative positioning of the patient.

Scleral Indentation

Indirect ophthalmoscopy and scleral indentation or scleral depression are performed for 360 degrees to visualize the peripheral retina, ora serrata, and pars plana. Indentation gives the examiner the opportunity to evaluate the fundus from a different profile or perspective. Scleral indentation is a dynamic rather than a static examination. The ability to observe retinal structures as they pass over the crest of the indentation is a unique feature of this technique. Frequently, barely perceptible lesions will be clearly visualized using scleral indentation, and the examiner may better appreciate differences in tissue colors, densities, or separations. Visualization may be limited by dense peripheral cortical spoking in the crystalline lens or opacities in the vitreous.

Scleral indentation is usually performed with the depressor on the surface of the patient's lids (Fig 1–7). Pressure should be applied tangentially rather than along the axis of the shaft of the depressor. Since the patient is often most uncomfortable with scleral depression in the superonasal quadrant, the examiner must be as gentle as possible when indenting in this location.

When performing scleral indentation, the examiner must be certain of alignment of his or her head and eyes, the condensing lens, and scleral depressor (Fig 1–8). The tip of the depressor becomes a fourth locus on the straight line passing through the patient's pupil, the center of the condensing lens, and the examiner's pupil. When one is learning scleral depression, the patient positions the eyes appropriately, and the examiner looks at the dilated pupil through the indirect ophthalmoscope without using the condensing lens. The examiner will see a dark oval surrounded by an orange halo in the pupillary space. If the scleral depressor is placed in the correct position on the eye, the orange halo will darken. The condensing lens is then positioned perpendicular to the examiner's visual axis, and the indentation created by the scleral depressor will be visible. Continued alignment is important, and the examiner must move the scleral depressor in a direction opposite to that in which he or she desires the depression to appear in the field of view of the condensing lens. For example, if the indentation in the field of the con-

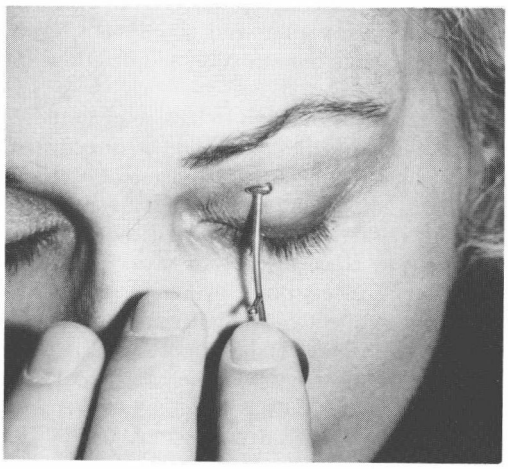


FIG 1–7.
The scleral depressor placed tangentially on the patient's upper lid.