

PHOTOGRAPHY OF THE PERIPHERAL RETINA

OPT 699: Special Studies

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Introduction

Photographing an ocular condition or disease process has long been recognized as a useful way to document the condition for comparison at a later date. At the Ferris clinic photography also plays an important role in teaching all aspects of clinical optometry, but is perhaps most important in the teaching of pathology. Each year over a thousand photographs are taken of various disorders. Many of these photographs are of the posterior fundus and are taken by the Cannon Non-Mydriatic Camera. While this instrument is capable of taking excellent photographs of the posterior fundus, it is incapable of photographing the fundus any further anterior than the equator. The purpose of this project, therefore, is to develop a system by which the peripheral retina can be photographed. The technique to photograph these areas of the peripheral retina was first developed by Gary Walters of the School of Optometry, Indiana University.

The technique involves photographing the aerial image produced by a condensing lens used in binocular indirect ophthalmoscopy. Using such a system affords one all the advantages of binocular indirect ophthalmoscopy, plus the added benefit of being able to record the image on film. The advantages realized by indirectly photographing the eye through the condensing lens are; (1) a wider field of view, (2) the reduction of distortion from corneal curvature and induced astigmatism and (3) the ability to view more peripheral areas of the fundus. The disadvantages incurred using the technique are: (1) small image size, (2) the need to dilate the pupil, (3) the inverted image, and (4) difficulties in achieving proper alignment.

The system employed in this project is shown in Figure 1. The Kowa hand held fundus camera was chosen rather than a regular 35mm camera because it has a built-in light source, and allows one to hold, focus, and release the shutter with one hand. This frees the other hand to align the condensing lens and/or hold the patient's lids open.

The condensing lens need not be attached to the camera as depicted in the photograph but such attachment greatly facilitates proper alignment. Therefore, it is highly recommended. Support devices are commercially available for about \$200.00, but I was able to fabricate an acceptable device for less than \$2.00 using a $\frac{1}{4}$ " threaded steel rod and an old electronic strobe flash unit. The "hot-shoe" from the flash unit was removed and attached to the Kowa camera via the mounting bracket which is normally used with the optional stand. A knurled ring on the "hot-shoe" firmly attached it to the camera. The threaded rod was then attached to the device via a pre-drilled hole, and the distance from the camera to the lens was then determined by experimenting with a model eye. Once the proper distance was determined, the rod was bent so that the condensing lens would center in front of the camera lens. A 20.00 D Nikon Aspheric condensing was then attached to the rod by means of a radiator hose clamp and then wrapped with electrical tape to prevent injury due to the protruding metal strip.

Initial testing with the model eye determined that the best photographs could be obtained using Ektachrome ASA 200 with the intensity levels on the power unit set at maximum and with the magnification of the camera set at 2X. At this magnification, the condensing lens filled the entire field.

As in binocular indirect ophthalmoscopy, the best view is obtained

when the patient is maximally dilated. After careful history, angle grading and intraocular pressure measurements, each patient was dilated using one drop of 2½% phenylephrine and one to two drops of ½% tropicamide.

— The patients were usually sufficiently dilated within 20 to 30 minutes.

Photographing the peripheral retinal using this technique is not an easy task and often requires two people to properly align the instrument. Alignment is difficult because one is viewing through a high powered condensing lens. This lens always produces a very blurred image except when held at the exact distance from the eye which focuses the aerial image at the point conjugant to the film in the camera. Once a clear image is in the focus, positioning the system is also made difficult because of the inverted image. The situation is similar to that seen in binocular indirect ophthalmoscopy. The final difficulty occurs because of the bright light source. The illumination required to see the fundus is quite intense and consequently, quite uncomfortable to the patient. Patients react to the bright light by squinting of the eyelids. Gentle retraction of the upper eyelid is almost always required.

Despite all attempts to fully dilate, properly align, and retract the eyelids; many of the pictures will fail to turn out. It is very important that each lesion be photographed several times to ensure at least one good picture. Despite the difficulty in using this instrument, good quality pictures can be obtained. With practice, this technique could be very useful in the clinic situation.

The following pages list some peripheral retina conditions and a brief discussion of each. By no means is this list to be considered complete, nor are the conditions discussed in full detail.

Anatomy of the Peripheral Retina

The peripheral (anterior) retina is usually considered to be that area which begins approximately 3mm posterior to the anatomical equator and extends anterior to the ora serrata. The posterior margin of the area may be approximated by a circle passing through posterior edge of the sclera entrance of each vortex vein. These veins, usually four in number, form the venous drainage system for all parts of the choroid and usually have a whorl-like appearance due to the radial and curved vasculature draining into the dilated stem known as the ampullae. Occasionally, the typical appearance may be absent when the tributaries converge directly into the scleral canal rather than the ampullae. In myopic eyes, the location of the vortex veins may be more posterior, sometimes near the optic disc, therefore, caution should be exercised when using these structures for landmarks.

The peripheral retina may be divided into two regions; the equatorial and ora serrata regions. The equatorial region is about four disc diameters on either side of the anatomical equator. The ora serrata region is approximately three disc diameters wide and extends on either side of the ora serrata.

The peripheral retina may also be divided into four quadrants. The long ciliary nerves and arteries running horizontally divide the retina into its superior and inferior halves while the vertical meridians are composed of two poorly vascularized strips which represent boundaries between two vortex systems. Often a short ciliary nerve or artery may be seen at the vertical meridian to aid in the identification.

The long ciliary nerves and arteries are derived from the nasociliary nerve and ophthalmic artery respectively and supply the very anterior

portions of the eye. They pierce the sclera on either side of the optic nerve separately but once inside the sclera, they lie very close to one another. The long ciliary nerve splits into two branches and lies on either side of the long ciliary artery as it passes anterior at a very oblique angle. In the equatorial region, the complex turns inward and thus becomes visible to ophthalmoscopy.

In the peripheral fundus it is very difficult to differentiate between retinal arteries and veins. The two are evenly distributed and do not run together. The best way to distinguish if one is looking at an artery or vein is to trace the vessel back to a more posterior portion of the fundus. The vessels become very small near the ora and usually disappear one half disc diameter from the ora with the arteries usually disappearing first.

The ora serrata marks the end of the retina. It is located 8.5mm from the equator. In this region, sensation to light ceases and the retinal structure is continued by nonpigmented ciliary epithelium which is considerably thinner than the retinal tissue. The ora serrata forms an irregularly shaped scalloped border with tooth-like processes extending anteriorly and the more rounded oral bays extending posteriorly. These morphological shapes are most pronounced in an area beginning one-half hour temporal to the 12:00 meridian and extending nasally to about one-half hour nasal of the 6:00 meridian. On the temporal side, the ora serrata is characterized by a wavy line rather than the more distinctive dentate processes as seen on the nasal side. Because of this, the exact number of ora teeth has been difficult to calculate but is usually considered to be between 20 and 30.

The vitreous base is the site where the sensory retina, pigment epithelium and vitreous are firmly attached to one another. It involves

TABLE 1

AVERAGE DIMENSIONS OF ADULT RETINA

Equator to Ora Serrata

Superior	5.07mm \pm 1.11
Inferior	4.79mm \pm 1.22
Nasally	5.81mm \pm 1.12
Temporally	6.00mm \pm 0.76

Diameter at Equator

Vertical	24.08mm \pm 0.94
Horizontal	24.03mm \pm 1.04

Diameter at Ora Serrata

Vertical	20.41mm \pm 1.09
Horizontal	20.03mm \pm 1.04

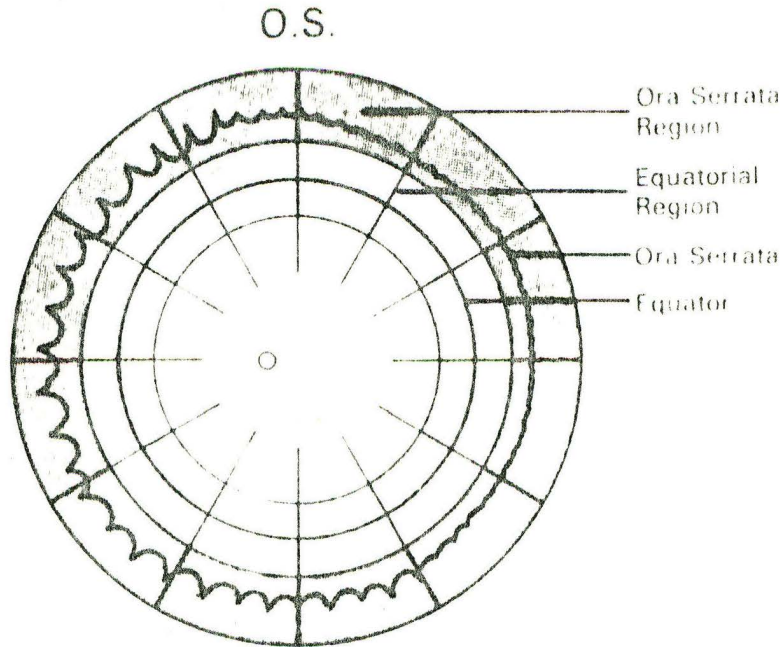
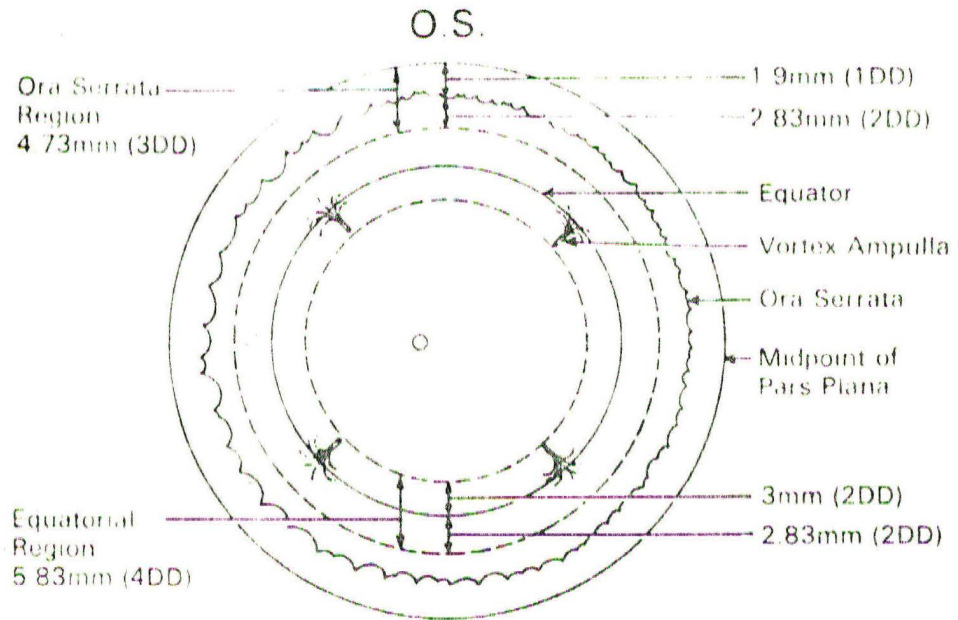


FIG. 1-1. The posterior pole and peripheral fundus. The peripheral fundus is divided into an ora serrata region and an equatorial region. The midpoint of the equatorial region is termed the equator.

FIG. 1-2. Ora serrata and equatorial regions. The ora serrata region is 4.73 mm in width the equatorial region is 5.83 mm in width. The ampullae of the vortex vessels represent the posterior limit of the peripheral fundus



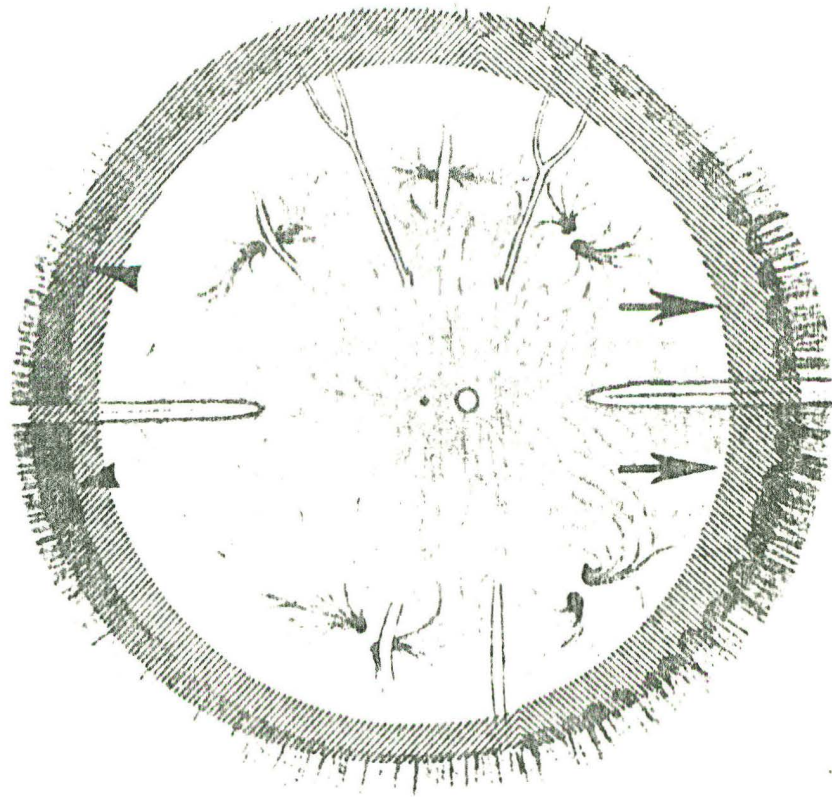


FIG. 1-9. The vitreous base straddles the ora serrata eccentrically and on the nasal side is primarily posterior to the ora serrata (large arrows, right), while on the temporal side, it is primarily anterior to the ora serrata (small arrows, left).

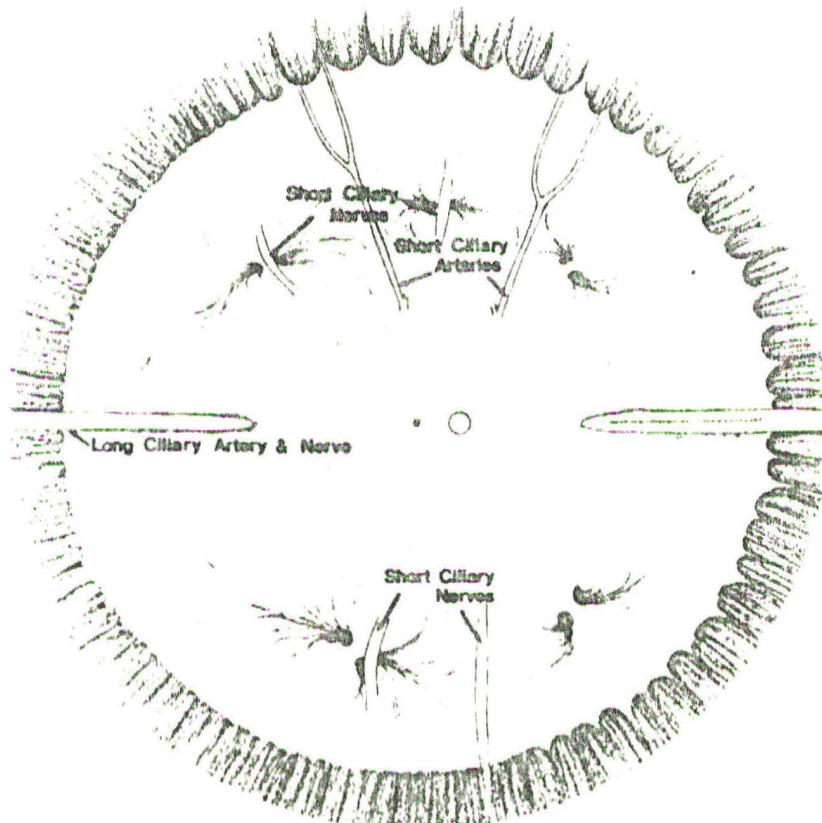


FIG. 1-7. Fundus landmarks. In the horizontal meridian the long ciliary artery and nerve are seen. In the vertical meridian the short ciliary nerves and the short ciliary arteries just to either side of the vertical meridian are important landmarks. The ora bays are much better defined on the nasal side of the ora than on the temporal side.

FIG. 1-4. Variation of vortex vessels: Tributaries as they exit from the fundus. (Modified from Drs. V. Rutuin, C. L. Schepens.)

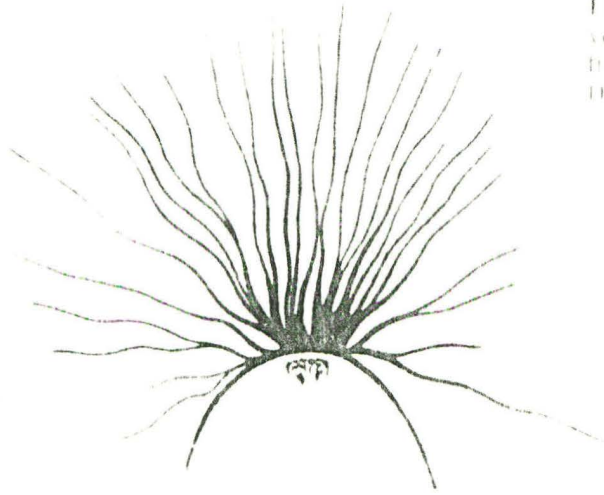


FIG. 1-5. Variation of vortex vessels: Tributaries entering a vortex vein before it exits from the fundus. (Modified from Drs. V. Rutuin, C. L. Schepens.)

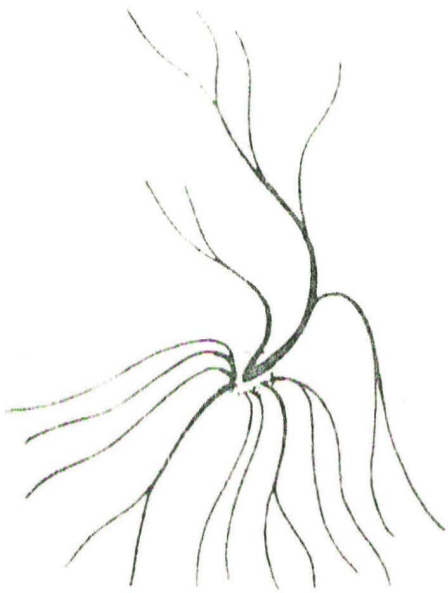
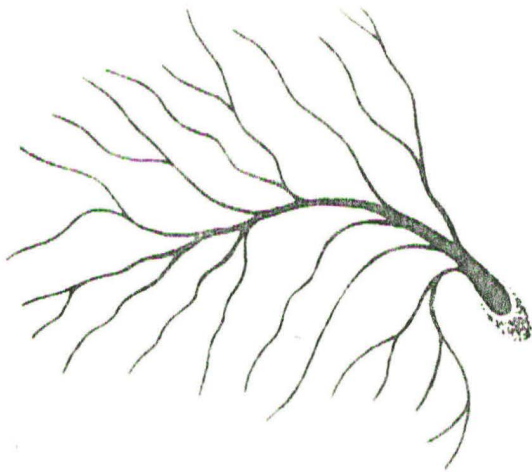


FIG. 1-6. Variation of vortex vessels: Vortex veins entering an ampulla before it leaves the fundus. (Drs. V. Rutuin, C. L. Schepens.)



the full circumference of the peripheral retina and extends from approximately 1.5mm anterior of the ora to approximately 1.8mm to 3.0mm posterior of the ora. It usually extends further posterior on the nasal side. This structure is of clinical importance because retinal breaks often occur along its posterior border and in some cases of traumatic detachment, the vitreous base may be avulsed with its underlying sensory retina and pigment epithelium creating a retinal dialysis.

Anatomical Variations

Numerous variations occur in peripheral fundus. One of the most common variations is the presence of deep ora bays. These deep bays usually occur on the nasal side and are characterized by a bay which may be up to four times as deep as the adjacent bays. The dentate processes bordering a deep bay may also be somewhat larger than normal. Occassionally, a tooth may be bifurcated or may join with another tooth to form a ring tooth and completely enclose an ora bay. These occurances are most frequently seen in the superior nasal quadrant.

Another common variation is meridional folds. These folds involve an inward elevation of all retinal layers and run posteriorly and perpendicularly from the ora serrata. The ridge-like appearance of the folds may be the result of retinal stretching in an anteroposterior direction and have been observed in about 20% of autopsied eyes.

A condition seen in about 10% of all patients is peripheral retinal excavation. This condition is characterized by an oval depression or pit in the retina and is aligned with a meridional fold or complex about 1.0 to 7.2mm from the ora serrata. They are usually present at birth, persist throughout life, tend to occur symmetrically in corresponding positions

in opposite eyes and are commonly associated with an abnormal alignment of a dentate and a ciliary process.

Degenerations

The most common degeneration of the peripheral retina is cystoid degeneration. It is present in all patients over the age of eight years and increases in area with advancing age. It has a uniform stippled appearance and is most extensive in the superior and temporal quadrants.

The condition appears as a gray band (on) zone just posterior the ora serrata and often stops at the posterior border of the vitreous base, although sometimes it will extend behind the equator. In its early stages, small clear spaces are present in outer plexiform layer. In the advanced form, the sensory retina is replaced with large cysts which coalesce and form broad areas of splitting in the peripheral retina.

A condition which often occurs with cystoid degeneration is reticular cystoid degeneration. This condition is located posterior and adjacent to typical cystoid degeneration and is characterized by a prominent linear pattern that corresponds to the retinal vessels and by a finely stippled internal surface. It is present in 18% of adult patients.

Degenerative retinoschisis is a sequela to progressive cystoid degeneration. It is a bilateral and often symmetrical condition which results from the coalescence of the microcysts of cystoid degeneration to form a separation in the sensory retina, usually at the outer plexiform layer. The degeneration may involve the entire periphery and produce either a flat or bullous type of retinoschisis. The flat type appears to be an exaggerated form of cystoid degeneration while the bullous type appears as a large, thin, elevated layer of tissue. The retinal vessels may appear

white and their shadows may be seen on the background fundus. Complications are rare, but with the bullous type, one must be watchful of retinal detachment or progression towards the posterior pole. Since retinoschisis may be clinically similar to rhegmatogenous retinal detachment or malignant melanoma of the choroid, careful differential diagnosis must be exercised.

^{sp} Pavingstone, or cobblestone degeneration, is a chronic, slowly progressive disorder with little or no significant symptoms or complications. The degeneration is characterized by well-delineated, flat yellow lesions with irregular black pigmentation along the margins. Red lines passing through the lesion correspond to the retinal and choroidal vasculature. It is present in 22% of adult patients and is most often located inferiorly between the 5:00 and 7:00 positions. Pavingstone degeneration may resemble inactive toxoplasmic retinochoroiditis, lattice degeneration or retinal holes.

Retinal holes of the peripheral retina are rounded, full thickness retinal breaks without a flap or free operculum. These holes are usually located in the vitreous base and are present in about 0.4% of adults. The surrounding retina is usually normal and proliferative reactions are usually absent. Most holes of this type do not produce retinal detachments, although holes located posterior to the vitreous may lead to progressive ^{sp} rhegmatogenous retinal detachments.

Lattice degeneration is a common disorder which is characterized by a circumferentially oriented, sharply demarcated area of retinal thinning and adjacent vitreous abnormalities. Its distinguishing features include an ^{u. a. 2} orborizing network of fine white lines, alterations of the retinal pigment, round punched out areas of retinal thinning or hole formation, liquefaction of the adjacent vitreous, exaggerated vitreoretinal attachments and a predilection for retinal tears. Each lesion may range from 30° to 120° in

length along the circumference of the eye near the equator. Several parallel rows may be present and affect 270° or more of the globe ^{S.P.} circumference. Strong vitreal attachments may cause retinal tears along the posterior margin following posterior vitreous detachment. The condition is present in approximately 10% of adult eyes. Although lattice degeneration may be responsible for many rhegmatogenous retinal detachments, the very great majority of these patients are asymptomatic.

Full thickness tears of the peripheral retina are usually the result of vitreal traction. The tear is usually V or U shaped with the base directed anteriorly. Occasionally, the flap may be completely avulsed and can be identified as a free operculum in the vitreous. These tears are present in about 7% of adult eyes and are most prevalent in the inferior temporal quadrant, posterior base and are always associated with posterior vitreous detachments. Left untreated, retinal tears may result in rhegmatogenous retinal detachments.

Developmental Abnormalities

Colobomas are a common developmental abnormality which typically affect the inferior nasal quadrant. The lesion appears as a depressed yellowish white area extending from the ciliary body to a variable distance posteriorly. The borders of the lesion are sharp and often have clumping of pigment. The condition is often associated with an iris or lens coloboma of the same quadrant. In advanced cases, the coloboma may affect the optic disc and macula as well. No treatment for colobomas is available but the condition should be monitored for retinal detachments.

Hypertrophy of the retinal pigment epithelium may be found anywhere in the fundus. The condition appears as a dark black, sharply delineated lesion. When it occurs in the periphery, the lesion may be extensive and often gives the illusion of elevation when examined by indirect ophthalmoscopy. The condition may occur as solitary type or as a multifocal type. When multiple lesions occur, a larger lesion may be surrounded by several smaller lesions suggesting an animal paw print appearance, hence the name, bear track lesions.

Hereditary Disorders

Choroideremia is an x-linked recessive trait that affects only males and is characterized by an atrophy of the choriocapillaris and pigment epithelium. The process begins in the periphery with degeneration of the photoreceptors. Initially there are areas of pigmentation and depigmentation that are most marked in the equatorial region. The pigment granules have an irregular, square appearance much like chunks of coal. As the condition progresses, the white sclera shows in the equatorial region and gradually spreads centrally and peripherally until all vision is lost.

Gyrate atrophy is a condition similar to choroideremia that is transmitted autosomal recessive. It is a rare condition which starts in the periphery of the fundus and is characterized by patchy atrophy of the choroid, pigment epithelium, and retina. In its final stages, this condition has a similar appearance to choroideremia.

Retinitis pigmentosa is transmitted x-linked recessive, autosomal dominant, or autosomal recessive. No physical findings may be present when the symptoms of night blindness first presents but as the condition

TABLE 3-2
Some Hereditary Conditions Associated with Retinitis Pigmentosa

Disorder	Inheritance Pattern	Other Findings
Laurence-Moon-Biedl Syndrome	Autosomal recessive	Mental retardation, polydactyly, obesity, hypogenitalism, deafness
Retsum's Disease	Autosomal recessive	Polynuropathy, ataxia, increased phytanic acid, deafness
Cockayne's Syndrome	Autosomal recessive	Dwarfism, precocious senility, mental retardation, deafness
Goldmann-Favre	Autosomal recessive	Cataracts, optically empty vitreous cavity
Hallgren's	Autosomal recessive	Retinoschisis, retinal detachment, cerebellar ataxia
Usher's Syndrome	Autosomal recessive	Deafness
Bassen-Kornzweig Syndrome	Autosomal recessive	Acanthocytosis, abetalipoproteinemia, ataxia
Friedreich's Ataxia	Autosomal recessive	Posterior column disease, nystagmus, ataxia
Pelizaeus-Merzbacher Disease	X-Linked recessive	Spasticity, cerebellar ataxia, dementia, "wandering eyes"
Mucopolysaccharidosis Type I (Hurler's Syndrome)	Autosomal recessive	Gargoylism, corneal clouding, mental retardation
Type II (Hunter's Syndrome)	X-Linked recessive	Mental retardation, skeletal abnormalities, hepatosplenomegaly
Type III (Sanfilippo's Syndrome)	Autosomal recessive	Mental retardation
Type IV (Morquio's Syndrome)	Autosomal recessive	Skeletal abnormalities, corneal clouding

progresses, however, "bony specules" scattered throughout the midperiphery along blood vessels may be observed. The degeneration continues anteriorly and posteriorly to form a ring scotoma, while the retinal arterioles become attenuated and the disc atrophies.

Inflammatory Diseases

Idiopathic peripheral uveoretinitis is a chronic inflammatory process involving the peripheral fundus and vitreous. It is most common in children and young adults and is usually bilateral. Vision is decreased, intraocular pressure may be decreased, and there may be cells and flare in the anterior vitreous. Dilation of the peripheral vessels with occasional perivascular exudates may occur along with white exudates in the region of the vitreous base, usually inferiorly. The most common complications are, cataract and macular degeneration although vitreal organization and traction may lead to retinoschisis or retinal detachment. The condition may be treated with steroids.

Nematode endophthalmitis by the second-stage larva of the dog roundworm, Toxocara canis, is a common cause of intraocular inflammation. When it involves the peripheral retina it produces an isolated granuloma with severe mass that may be mistaken for a retinoblastoma. As the mass shrinks, it may cause dragging of the retina and formation of retinal folds. Progression of the condition leads to traction bands, retinal detachment and phthisis bulbi. Treatment is difficult although corticosteroids may be of some benefit.

Sarcoidosis is a condition of unknown etiology which is most common

in Blacks. It is associated with arthritis, lymphadenopathy, fever, and numerous central nervous systems disorders. In the peripheral fundus, the condition may cause retinal periphlebitis, retinal hemorrhages, subretinal granulomas, vitreous opacities, and exudates in the pars plana. In severe cases the typical "candle-wax drippings" may be seen. There is no treatment for sarcoidosis although corticosteroids may reduce the inflammation.

Toxoplasmosis is caused by the protozoon, Toxoplasma gondii, and may be either acquired or congenital. The acquired type is usually less severe. Although the condition usually affects the posterior pole, both types may also affect the peripheral fundus as well. In its acute stage, the lesion appears fluffy white with an overlying vitreous inflammation. Several pigmented satellite lesions may also be observed adjacent to active sites of inflammation. In the chronic stage, the condition appears as a punched out chorioretinal lesion with pigmented borders in which the sclera can be easily seen. When the disease is in the peripheral retina, no treatment is advocated. If vision is threatened, then treatment with pyrimethamine and a sulfonamide may be initiated.

Vascular Abnormalities

Diabetes Mellitus is a common condition which affects about 10 million people in the U.S. It is a serious condition which is responsible for 41 percent of all cases of blindness in males and 58 percent of all cases of blindness in females. There are two types of retinopathies associated with the condition; background and proliferative diabetic retinopathies. The background diabetic retinopathy primarily affects the posterior pole and is characterized by microaneurysms and retinal hemorrhages, exudation,

and macular edema. Proliferative diabetic retinopathy on the other hand is characterized by extraretinal proliferation of vessels which may result in retinal breaks and detachments, and intractable vitreous hemorrhage. The peripheral fundus in diabetes is affected not so much by the disease process itself, but by traction on the retina by contraction of the vitreous following proliferative diabetic changes. As the vitreous contracts, retinoschisis, retinal detachments or retinal holes may form. About 75 percent of the retinal detachments which occur as a result of diabetes are of the nonrhegmatogenous (tractional) type, and about 20 percent are of the rhegmatogenous type (caused by retinal breaks). The nonrhegmatogenous detachments very seldom extend anterior to the equator and appear as an elevation with a taut shiny surface, with demarcation lines, and have no shifting of subretinal fluid or mobility of the retina. In rhegmatogenous detachments, the borders may extend to the ora serrata, the retinal surface appears dull and grayish, and undulates because of shifting subretinal fluid and retinal mobility. When these detachments occur, surgical intervention may be indicated.

Retinal vein occlusion is the second most common cause of proliferative diabetic retinopathy. The most common site of retinal vein occlusion is the superior temporal vein, perhaps because it has a higher number of arterio-venous crossing than the other veins. The same peripheral retina considerations must be made as with diabetic retinopathy i.e. detachments, however, it is rare that such detachments ever occur. When they do occur, then surgical repair is necessary.

Retrolental fibroplasia is a condition which results from oxygen therapy for the neonate in respiratory distress. Detailed pathogenetic

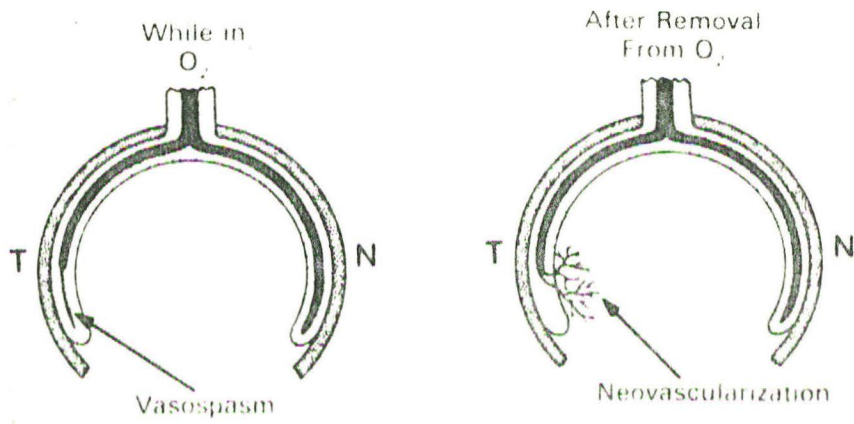
mechanisms are beyond the scope of this paper but let it suffice to say that it is the immature blood vessels that are affected by high oxygen tensions. Under these conditions, they undergo a vaso-occlusive and vaso-obliteration effect so that when oxygen levels return to normal, the surrounding area becomes hypoxic. Tortuosity and neovascularization toward the area of retinal ischemia occurs leading to local hemorrhage and fibrotic proliferation. A grading system has been proposed by McCormick and Kingham and is listed on Table 2. The peripheral retina changes in Grade I retrolental fibroplasia include; pigment clumping and patches of pigment loss, peripheral vitreous membrane formation anterior to the equator, and equatorial retinal folds between the equator and the ora serrata along the vascular demarcation line. Neovascularization may occur near areas of retinal ischemia in Grade II R.F. along with lattice degeneration and the formation of retinal breaks. In Grade III R.F. a thickened retinal fold which terminates in a gliotic mass at the vitreous base may be present. Grade IV retrolental fibroplasia is characterized by retinal detachment which results from multiple rather than single retinal breaks. The average age for such detachments is 5.7 years and is treated by a combination of scleral buckle surgery and cryotherapy. In Grade V retrolental fibroplasia the retina becomes organized to form the characteristic white pupil and does not respond to any treatment.

Tumors of the Retina

Retinoblastoma is the most common intraocular tumor in childhood. It is congenital but does not become apparent until the age of one or two. There appears to be some inheritance, perhaps by autosomal dominant, but 94 percent of the cases appear to be sporadic mutations. Patients with retinoblastomas usually present with a white pupil due to the large mass or less

FIG. 6-15. Retrorenal fibroplasia: Diagram showing spasm of peripheral vessels on the temporal side followed by early neovascularization in the area of anoxia.

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commonly with strabismus, intraocular inflammation, vitreous hemorrhage or glaucoma. The tumor may be located anywhere in the retina but when located in the peripheral fundus, the tumor may become very large before any signs are presented. Peripheral retinoblastomas appear as white, elevated, smooth lesions. Occasionally the lesion may appear irregular due to the presence of calcium in the tumor. Several large blood vessels may supply the mass and destroying these vessels is one mode of treatment. Unlike tumors in the posterior pole, retinal detachment associated with peripheral retinoblastomas are rare. The differential diagnosis includes; retinal astrocytoma, capillary hemangioma, early Coat's disease, nematode granuloma, peripheral uveoretinitis, retrolental fibroplasia and organized hemorrhage.

Capillary hemangiomas may occur anywhere in the fundus and are characterized by one or more red or pink masses with yellow exudation in the outer retinal layers. This exudation may lead to exudative retinal detachment.

Choroidal nevi are nonprogressive lesions which are relatively flat, slate gray in appearance, and range from one-half to 7 or 8 disc diameters in size. When located in the periphery, the patient is usually asymptomatic but may experience a field defect when the condition affects the overlying retina. These changes in adjacent structures include; degeneration of the retinal pigment epithelium, drusen, and cystic retinal changes. Occasionally a choroidal nevus may undergo a neoplastic change to form a malignant melanoma.

Malignant melanomas are the most common cause of primary intraocular malignancy and may involve either the ciliary body or choroid. Malignant melanomas of the ciliary body may become quite large before being recognized

and may be discovered when seen through a dilated pupil. Other signs such as developing lenticular astigmatism or dilated tortuous episcleral blood vessels in one quadrant may signal the condition. An extraocular extension of the melanoma 3mm to 4mm posterior to the limbus may also signal the disorder. Small to medium sized peripheral choroidal melanomas appear as elevated, cream yellow to dark gray masses. They are usually of greater size and thickness than the benign choroidal nevi, and pigmentation may range from little to deep. Large melanomas may cause vision loss by extension into the visual axis or by retinal detachment. When large choroidal melanomas break through Bruchs' membrane, ophthalmoscopy reveals large dilated blood vessels on the dome of the mushroom shaped tumor and a large serous detachment. Treatment for this condition is very controversial with some authorities advocating immediate enucleation while others propose other less drastic measures.

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