A Dissertation On

A CLINICAL ANALYSIS OF 50 CASES OF PATHOLOGICAL MYOPIA

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CERTIFICATE

This is to certify that this dissertation entitled **A CLINICAL ANALYSIS OF 50 CASES OF PATHOLOGICAL MYOPIA** submitted by **Dr.R.UMA MAHESHWARI** appearing for Part II M.S Branch III (OPHTHALMOLOGY) degree examination in February 2007 is a bonafide record of work done by her under my direct audience and supervision in partial fulfillment of regulations of the Tamil Nadu, Dr.M.G.R.Medical University ,CHENNAI,TAMILNADU.I forward this to the Tamil Nadu , Dr.M.G.R.Medical University Chennai, Tamil Nadu, India.

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PART I

Introduction

INTRODUCTION

Eye is the most important sense organ of the human body. The primary responsibility of the visual function is carried out by retina. Pathological changes of retina can cause irreversible blindness. Myopia causes impaired visual acquity among school children as well as in adults. Retinal degeneration and retinal detachment is also commonly in myopic patients.

The retina is unique among the complex element of the central nervous system and the special senses.It may be readily viewed during life, and it is sufficiently transparent so that alterations within and adjacent to it may be observed in vivo.

For these and other reasons related to its structure , organization and function , the retina has been the ever- increasing importance in science as a whole and in the field of ophthalmology.

Consistence with this growing importance, methods of viewing the etina have steadily improved during more than a century since the principal of ophthalmoscopy was presented by Von- Helmhotz. As a result, current techniques of ophthalmoscopy and biomicroscopy facilitate clinical examination of the entire retina in detail.

Interpretations of the findings, however , depend on the accurate and detailed knowledge of retinal topography, anatomical relationships, common developmental variations and degenerations that commonly affect the retina.

Eyes with pathologic myopia are an eccentric group in which the myopia is more likely due to a disease than to a biologic variation.such eyes show excessive axial length with equatorial scleral expansion ,dehiscences and posterior staphyloma formation.Global expansion can slowly progress during a persons life time and result in blinding complications. Pathologically myopic eyes have erros of -6.00 D or greater,in excess of -40.00 D. With recent technologies like Bscan, ICG,FFA and OCT we are able to understand and monitor the underlying pathology and structural alterations in a better manner.

Historical Review

HISTORICAL REVIEW

The word **myopia** is derived from the Greek word **müopia**, which means contracting or closing the eyes.

ARISTOTLE- first person who noted the tendency of myopes to blink and write in small script

FRANS CORNELIS DONDERS (1818-1889)- first to analyse the various types of refractive error.

NEWTON (1704)- noted that axial length is the sole determinant of refraction.

PLEMPIUS (1632)- proved that in myopes the axial length is more

SCARDIA (1801) - The first person who anatomically described posterior staphyloma.

VON AMMON (1832)- pointed out that posterior staphyloma was due to distension of the posterior pole.

VON GRAEYE and VON JAEGER (1854) – postulated the association of myopia and posterior staphyloma.

ARLT (1856) – association of myopia with axial elongation.

REHSTEINER (1928) - .noted the peripheral degenerative changes in pathological myopia.

STENSTROM (1946) – Measured the ocular axial length directly by X-rays.

PERCIVAC (1987) – axial length in addition to pathology is a factor associated with retinal detachment.

KREMER and Co-workers – high myopes showed the presence of multiple atrophic retinal holes in the posterior pole.

BURTON – refractive error and lattice degeneration on detachment.

MORITA and Coworkers – risk factors associated with retinal detachment

ANATOMY AND TOPOGRAPHY OF RETINA

CENTRAL RETINA

The retina proper is a thin, delicate layer of nervous tissue that has a surface area of about 266 mmsq.The major landmarks of the retina are **the optic disc, the retinal blood vessels, the area centralis with fovea and foveola, the peripheral retina** (which includes the equator) and **the ora serrata**.The retina is thickest near the optic disc , where it measures 0.56 mm,becomes thinner towards the periphery.

THE OPTIC DISC

The optic nerve head, the collection point for the axons of its ganglion cells is the optic disc.The disc is a circular to slightly oval structure (1.5mm), which contains a depression in the centre,the physiological cup. The centre of the optic disc is about 4 mm nasal to the fovea.The optic nerve head receives about 1.2 million retinal axons ,which turn at about right angle to enter the optic nerve. Its centre is 3.42 mm medial and 0.1mm inferior to the fovea. Its vertical diameter

is 1.86 mm and horizontal diameter is 1.75 mm **(Straatsma, Foos, Spencer, 1969)** and it lies 27 mm from the nasal and 31 mm from the temporal limbus. The axons pass through the multi lamellar fenestrations of the collagenous lamina cribrosa which occupies the posterior scleral foramen.Optic disc head is supplied by branches of short ciliary arteries, except for its layer of nerve fibres which is supplied by the central retinal artery.

THE AREA CENTRALIS

The central retina is divisible into fovea and foveola, with a parafoveal and perifoveal ring around the fovea.This region of the retina located in the posterior fundus temporal to the optic disc is demarcated approximately by the upper and the lower arcuate and temporal retinal vessels and has an elliptical shape horizontally. With an average diameter of about 5.5 mm the area centralis corresponds to approximately 15 degree of the visual field.

FOVEA

Located at posterior pole of the globe, 4mm temporal to the centre of the optic disc and about 0.8mm below the horizondal meridian.

Diameter 1.85 mm , thickness o.25mm.The downwad sloping border which meets the floor of the foveal pit is known as clivus.

FOVEOLA

It is 0.35mm in diameter and 0.13mm in thickness. Represents the area of highest visual acuity.

MACULA LUTEA

It is an oval zone of yellow colouration within the central retina. Yellow coloration probably derives from the prescence of carotenoid pigment, xanthophyll in the ganglion and the bipolar cells**. (Tripathi & Tripathi 1984).**Pigment epithelium in the posterior fundus is less granular than at the periphery. Concentration of cone is maximum in the central retina.Ganglion cell layer is seen in two layers at the temporal side of the optic disc and is about 6-8 layers at the edge of the foveola.At the foveola and optic nerve head,the ganglion cell layer is absent.

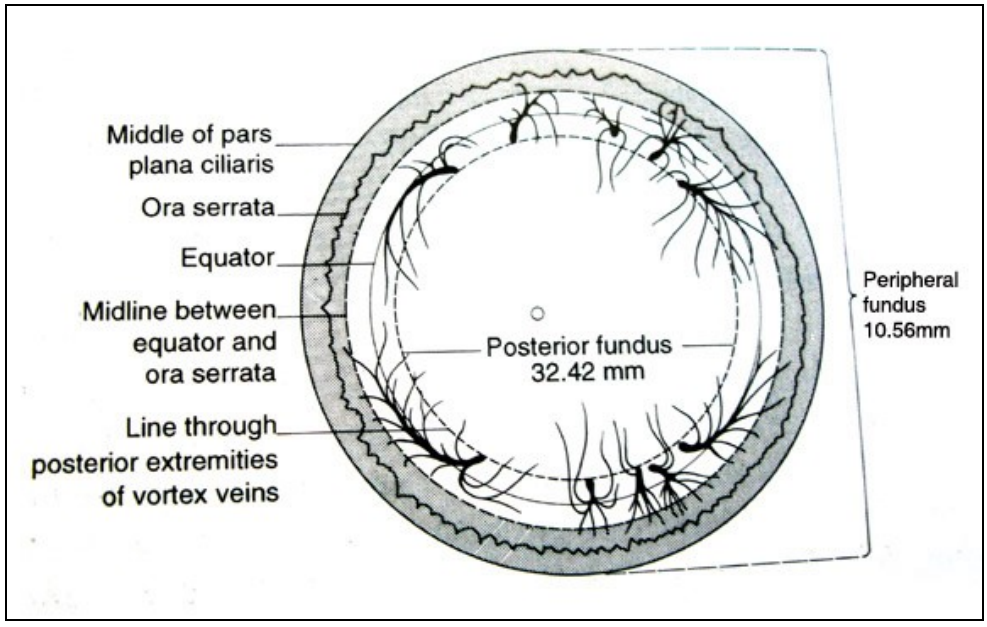
PERIPHERAL RETINA

The peripheral fundus is defined as the area anterior to the scleral entrance of the vortex to the middle of pars plana.It is divided into four regions – near periphery, mid periphery, far periphery and the ora serrata.

NEAR PERIPHERY – circumscribed region of 1.5 mm around the area centralis.

MID PERIPHERY – 3 mm around the zone of near periphery.

FAR PERIPHERY – Extends 9 – 10 mm on the temporal side and 16 mm on the nasal side on the horizontal meridian.

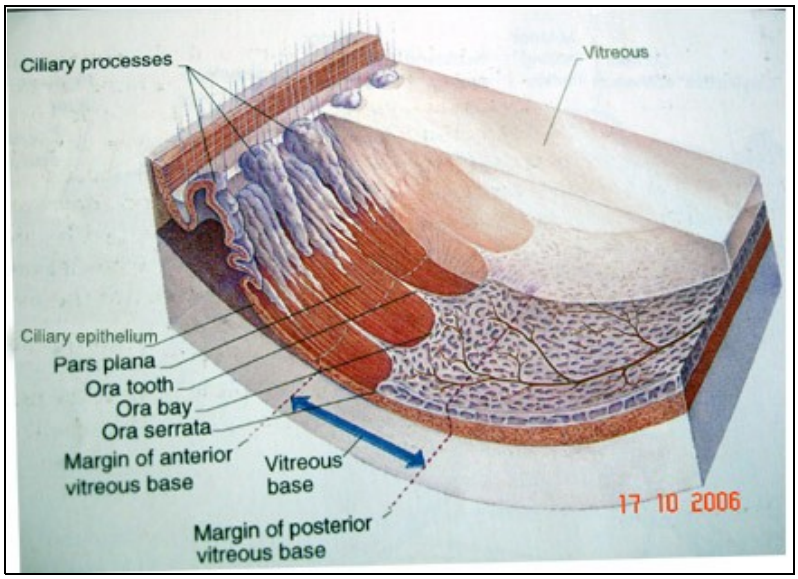


THE ORA SERRATA

The peripheral edge of the retina is the ora serrata.It marks the junction between the multilayered parsplana retina and the monolayered non-pigmented epithelium of the ciliary body.

VITREOUS BASE

Vitreous base is approximately 3.2 mm wide slightly wider naslly and narrow temporally.Anterior portion of the vitreous base is the zone between ora serrata and the origin of the anterior hyaloid membrane.Anterior vitreous base is generally conformed to the contour of the ora serrata.The posterior portion of the vitreous base is the zone of strong retinovitreal attachment that extends posterior to the ora serrata



AVERAGE MEASUREMENTS OF NORMAL EYE

	MILLIMETERS	DISC DIAMETERS
Circumference	76.85	51.0
Width of pars plana	3.80	2.5
MEASUREMENTS FROM LIMBUS TO :		
Middle of pars plana ciliaris	6.10	4.0
Ora serrata	8.00	5.0
Limit between oral region and equatorial region		
Equator	13.66	9.0
Scleral entrance of vortex veins	16.66	11.0

MEASUREMENT IN FUNDUS:

Equator and scleral entrance of vortex veins	3.00	2.0
Equator to ora serrata	5.66	4.0
Width of equatorial region	5.83	4.0
Width of oral region	4.73	3.0
Width of peripheral fundus	10.56	7.0
Macula to limit of central fundus	16.21	11.0

EPIDEMIOLOGY

PREVALENCE OF MYOPIA

Prevalance of myopia varies with age, sex and other factors.Most infants reach emmetropia by 2 -3 years of age. Prevalance of myopia increase in school age and young adults reaching 20% – 25 % in mid to latte teenage population and 25% – 35 % in young adults.Studies have found a slightly higher prevalence of myopia in females than in males.The prevalence of myopia increases with income level and educational attainment and it is higher among persons who work in occupation requiring great deal of near work.

Among children in India, Shulka found myopia to increases from below 5% at 5 years to 20% at 20 years. Mc laren compared 2 groups of Indian children in which one group who had nutritional supplement

showed better general development, also had a slightly higher prevalence of myopia .

In an older population, Banerjee found35% of a college student group in Calcutta to be myopic. In India, Blan observed that 42% of people above the age group of 25 years exhibited either myopia or myopic astigmatism.In Goldschmidt's study the prevalence of myopia among girls was significantly greater than that among boys. According to APEDS study an estimated 30 million population would have myopia,15.2 million would have hyperopia in population of more than 15 years of age.

OPTICS OF THE EYE

Emmetropia is the condition in which the parallel beam of light come to focus on the retina , with the eye at rest.At birth the average axial length is 18mm, and infant eye undergoes rapid growth in the first

few years of life to reach an axial length of 23mm by the age**(Parsons' Disease of eye)**

Ametropia : The condition in which the incident parallel rays of light do not come to a focus upon the light sensitive layer of retina.

TYPES OF AMETROPIA

Axial ametropia : Abnormal increase in length of eyeball (an 1mm elongation produces approx 3D of myopia).

Curvature ametropia : Abnormal curvature of the refracting surfaces of the Cornea or lens (1mm change in the radius of curvature of the cornea produces a 6.00 D refractive error.

Index ametropia : Abnormal refractive indices of the media.

MYOPIA

DEFINITION:

Myopia is that form of refractive error wherein parallel rays of light come to a focus in front of the sentinent layer of the retina when the eye is at rest.

CLASSIFICATION OF MYOPIA

Etiological Classification :

Axial Myopia :

This is the commonest type seen.It is due to an increase in the anteroposterior diameter of the eye. For every 1mm increase will cause 3.00 D increase in myopia.

Curvature Myopia :

This is seen due to an increase in the curvature of cornea or the surface of the lens.

Index Myopia :

Occurs due to change in the refractive index of the media. example - myopia seen associated with cataract and diabetes.

CLINICAL CLASSIFICATION :

Clinically there are two types of myopia.They are simple myopias and pathological myopias.

Simple myopia :

It is the physiological variant of the normal. This is a condition of limited progression. Simple myopia are of two types.

Physiologic Myopia :

Here each component of refraction lies upon its normal distribution curve. Postnatal development is normal. There is correlation failure between the total refractive power and a normal axial diameter. The heredity is multifactorial. Myopia of -3.0 dioptres and less is physiologic.

Intermediate Myopia :

Here there is increased expansion of posterior segment of globe. The entire posterior segment is involved. Generalized spreading and thinning of retinal pigment epithelium seen. Myopia upto -8.0 dioptres

associated with various fundus changes can be considered intermediate **(B.J.Curtin).**

Pathological Myopia :

Also called as malignant myopia. Determined by hereditary and postnatal factors. There is excessive axial elongation of the eye and a number of ocular complications. Myopia of -6.0 dioptres or more is considered pathologic.

PATHOGENESIS

Pathologic myopia is characterized by degenerative changes occurring particularly in the posterior segment of a highly myopic eye, often associated with lengthening of the anteroposterior axis of the globe. It connotes an extreme axial elongation in which degenerative as well as vascular alterations are superimposed.

The most common form of pathologic myopia is the isolated developmental form, where as in simple myopia the myopic tendency is restrained after puberty.In developmental pathologic myopia , the near sightedness may increase even more rapidly during adolescence and the axial enlargement may even slowly increase during adulthood into the 40s and 50s , with the eventual genesis of atrophic and degenerative intraocular changes leading to visual loss and possibly blindness.

Congenital axial pathologic myopia may also occur. This frequently is associated with other congenital defects such as colobomas and anomalies of pigmentation of the retina or choroid. The most common associated fundus conditions resemble partial albinism.

Varying degrees of myopia commonly are associated with ROP, microophthalmia, microcornea. microphakia, buphthalmos, the tapetoretinal dystrophies and down syndrome.

INHERITENCE

The pathogenesis of pathological myopia remains unclear. Previous reports have identified a locus for autosomal dominant pathologic myopia to gene 18p11.31. More recent findings posit the genetic heterogeneity of myopia by establishing linkage to a second locus at the 12q2123 regions High myopia is slightly more likely to develop in women than men, whereas the lower degrees of myopia generally are transmitted as a dominant trait . In higher degrees of myopia , which often begin at a relatively early age , recessive transmission is more common. Anisometropia , an unequal degree of

myopia in each eye , is the rule in most cases of high pathologic myopia, but gross inequalities greater than 3D are relatively unusual.

OCULAR CHANGES IN PATHOLOGICAL MYOPIA:

Clinically, a severe myopic eye generally appears large and prominent. The gross appearance of the highly myopic eye is egg or pear shaped and significantly enlarged. The cornea may be abnormally flat , the anterior chamber is somewhat deeper than normal and the ciliary muscles are atrophic . The ciliary muscle in a person with high myopia often is smaller than normal , probably because the myopic individual requires the less use of the muscles of accommodation.

CHANGES IN POSTERIOR SEGMENT :

The major changes are confined almost entirely to the posterior pole.

The first to correlate the histologic changes in myopia with the ophthalmoscopic changes was Von Graefe .These changes are summarized as follows:

1.**Scleral changes** – posterior enlargement of the globe and thinning of the sclera at the posterior pole with scleral ectasia and posterior staphyloma.

2.**Changes in the epipapillary and the peripapillary region** - oblique entrance of the optic nerve, tilted disc , myopic crescent , nasal supertraction.

3.**Changes in the choroid and retina** – atrophy and thinning , particularly affecting the posterior pole and the periphery. These changes include atrophy and/or proliferation of the pigment epithelium, formation of the Foster Fuchs spot at the macula, retinal microcystoid degeneration, and occasional peripheral retinal break formation and subsequent detachment.

4. **Degenerative changes in the vitreous**.

1. SCLERAL CHANGES

Scleral thinning with occasional formation of a posterior bulging or staphyloma of the sclera is common.The staphyloma may surround the optic nerve head and extend temporally to involve the posterior pole and sometimes even the equator. The normal sclera progressively

thickens from the equator backward, becoming thickest at the posterior pole. In a globe with severe myopia the opposite situation occurs; the sclera becomes progressively thinner posteriorly in the peripapillary region. When present, a staphyloma is lined by a thin, atrophic choroids, and the margins of the staphyloma usually reveal a relatively abrupt edge.

TYPES OF POSTERIOR STAPHYLOMA :

Mainly five primary varieties are seen. Their features are as follows

Type I:

Here tessellation and pallor will extend over a horizontal elliptical area. Site is nasal to disc margin commonest type seen.

Type II :

Called as macular staphyloma. Extends from the optic nerve to the temporal aspect of macula.

Type III :

Least common type. Involves a well circumscribed area around the disc called as peripapillary staphyloma.

Type IV : Nasal or inferonasal aspect of the optic nerve head is involved. There is associated inversion of the retinal vessels. Hence also called as inverse myopia

Type V :

Usually shallow and involves an elliptical zone below disc. Commonly considered as a form of choroidal coloboma.

2. CHANGES IN THE EPIPAPILLARY AND PERIPAPILLARY REGIONS

Ophthalmoscopically, the optic nerve head in acquired myopia is ovoid with the long axis in the vertical direction.Myopic degeneration usually makes their initial appearance in the crescent margin.In severe cases entire peripapillary area can be involved. In the typical myopic eye the disc appears tilted with the temporal side flattened which is surrounded by a concentric or crescent shaped area or areas of relative fundus depigmentation.

The myopic crescent invariably occurs in later years in patients with myopia greater than 6 D. The sclera is visible because of an absence of pigment epithelium and choroid, both of which fail to extend to the temporal margin of the disc. The crescent of acquired myopia are located temporally in approximately 80% of cases. In 10% of cases, the crescent may extend to become annular, surrounding the entire disc, sometimes even spreading to include a large area of the fundus with envelopment of the macular area. In rare instances, the myopic crescent is situated on the nasal side of the disc (inverse crescent).

3. CHANGES IN THE CHOROID AND RETINA

Atrophy of the choroids occurring predominantly near the posterior pole is almost consistent feature of severe pathological myopia.Initially the retinal pigment epithelium becomes attenuated and the choroids vessels become visible.Splits may develop in Bruch's membrane. These form clefts (lacquer cracks or lightning figures[German Lacksprunge and Blitzfiguren]),which seem to branch and have a reticular appearance. During the course of pathological myopia choroidal haemorrhages are seen. Usually seen in the macula. Can be isolated or along with lacquer crack formation. The plane is between retinal pigment epithelium and lamina vitrea.

LACQUER CRACKS

The ruptures of the lamina vitrea is seen as lacquer cracks. This appears as yellow white lines across posterior pole. Irregular in caliber. Usually multiple and are horizontally oriented. They may also show criss cross pattern. These lesions are traversed by large choroidal vessels posteriorly. The inner layers of the retina is normal. Associated with concentric contraction of the field. Acquired yellow blue colour vision deficiency is also seen. If they are in macula, central vision is impaired. Along these lesions focal areas of chorioretinal atrophy are seen.

FORSTER FUCH'S SPOTS :

Through the defect in lamina vitrea proliferation of choroidal fibrovascular tissues occurs. Thus a firm adhesions is seen between choroid and retina. This fibrovascular tissue can cause haemorrhage. There is marked proliferation of overlying retinal pigment epithelium. This forms an unique well defined, elevated, black lesion at the posterior pole of eye Foster Fuchs Spot.

DEGENERATIVE CHANGES IN THE VITREOUS :

Vitreous changes including liquefaction, microfibrillar degeneration and formation of opacities and floaters (muscae volitantes) may occur. Posterior detachment of the vitreous commonly occurs, probably because of stretching of the enlarged globe, leaving a gap between the posterior vitreous and the posterior pole of the eye.

DEGENERATIONS OF THE PERIPHERAL RETINA

Retinal hole

Is a more advanced tropic lesion, is manifest grossly as a round complete retinal break without detectable flap or operculum. These holes are commonly found in the anterior zone, usually in an area of relatively normal retina.

Cystoid degeneration

Inner wall of single cyst may be absent or broken giving the appearance of retinal hole. This is a pseudo-hole since the outer wall of the cyst is intact.

Another type of cystoid degeneration is the reticular cystoid degeneration of the peripheral retina, is almost invariably located posterior to and continuous with the typical cystoid degeneration. Retinal cystoid degeneration is present in 18% of adult patients, most prevalent in the infero – temporal quadrant.

Retinoschisis

This condition is a splitting of the neural layers of the retina which generally occurs in the outer plexiform layer. Typical degenerative retino schisis is a more extensive tropic process and presents as a round or oval area of retinal splitting with a smooth fusiform elevation of the inner layer and its blood vessels.

Paving stone degeneration:

Is characterized by one or more discrete rounded foci of depigmentation and retinal thinning located between the ora serrata and the equator. The lesion are yellow white frequently reveals the

underlying choroidal vessels and often has a pigmented margin. The basic lesion is rounded in shape and is one to several disc diameters in size , clusters of hese rounded foci may merge to form larger lesions with scalloped margin and incomplete pigmented septum.

Histologically characterisied by loss of retinal pigment epithelium and the outer retina with adhesion of the inner retina to the Bruch's membrane.

Paving stone degeneration does not predispose to retinal break or retinal detachment.

Chorioretinal degeneration:

This condition always extends round the fundus periphery. It begins and is most severe in the retina adjacent to the ora serrata. It spreads posteriorly and merges into the normal healthy retina without definite demarcation. Chorio-retinal degeneration is frequently associated with cystoid degeneration, both conditions more or less occupying the same area.The ophthalmoscopic appearance of chorio-retinal degeneration can be graded as mild, moderate or severe.

The changes are always severe adjacent to the ora serrata and mildest further posteriorly. Peripheral chorio-retinal degeneration begins to appear in the fourth decade of life and increase severely with the age. Males are more often affected than the females.

Chorio- retinal atrophy:

Is characterized by discrete areas of retinal and choroidal thinning. Pigment proliferation, and migration of the pigment in the retina re present around the edges of the lesion whose centre is pale and dirty grey. Atrophy of the inner choroidal layer clearly expose the large choroidal vessels.

Pigmentary degeneration:

Of the various types of peripheral changes, pigmentary degeneration is the leasts studied and least understood lesion. The pigmentation may vary from a fine diffuse darkening of the fundus to the presence of large discrete clumps. Pigment may be found in scattered clumps or granules or as localized clumps or may be diffusely distributed.Pigmentary degeneration has a tendency towards bilaterality and apparently no sex preference. Age does not seem to be an important factor.It has a tendency to be found with white without pressure or lattice degeneration or associated with silent retinal breaks.

White without Pressure :

Circumferentially arranged geographic white or grey areas are seen. They may be flat or elevated. The common site is inferior

quadrant, posterior to the equator. The surface is covered by glistening yellow white dots and fine lines.

White with Pressure :

Usually found in area of lattice and small retinal breaks. Also seen in eyes with vitreous and retinal detachments. These degenerative changes are benign lesions.

Lattice Degeneration :

Most common lesion linear or spindle shaped lesions are seen at or peripheral to equator. Sharply demarcated and circumferentially oriented. Variable amount of pigment proliferation is also seen. At the margins of these lesions vitreous adhesions are seen. Also associated with round holes. If traction present then tears are formed which cause detachment.

Opthalmoscopically over these lesions white interlacing lines are seen. They are hyalinized blood vessels which forma criss cross pattern. These lesions enlarge circumferentially and new lesions also form. Bilaterally involves superior temporal quadrant. Flourescein angiography shows poor or absent perfusion in these areas

COMPLICATIONS

1. Rhegmatogenous retinal detachment .
2. Choroidal thromboses and haemorrhages.
3. Cataract

4. severe visual impairment.
5. chronic simple glaucoma.

CLINICAL EVALUATION FOR PATHOLOGICAL MYOPIA

1. **Visual acuity –** Is the most important criterion of testing the functional integrity of the eye.
2. **Direct ophthalmoscopy –** Though the area of field observed is smaller, increased magnification obtained with this method allows detailed examination of the various details of the fundus.
3. **Indirect ophthalmoscope –** This technique is of special importance because it allows the examiner to form a clearer understanding of the cause and forces involved in the various pathological features involving retina and all the features are documented in a retina chart.
4. **Fundus fluorescein angiography –** Used to detect posterior pole changes like SRNVM,foster fuch's spots, lacquer cracks and early macular hole in cases of pathological myopia.
5. **Indocyanine green angiography –** Is superior to FFA in studying choroidal lesions because of certain physical properties of ICGA dye.Choroidal circulation and areas of neovascularisation lying beneath the retina show much better with **ICGA.** Hyperfluroscence is seen in patients with abnormal vessls or

neovascularisationof the choroid and leakage of the disc.Also seen in areas of atrophy of pigment epithelium.

6. **Ascan –** Is a one dimensional display in which echoes are represented as vertical spikes from a baseline.Ascan biometry helps to differentiate axial myopia from lenticular myopia.A posterior staphyloma in highly myopic eyes causes an increase in axial length.

7 **Bscan –** Produces a two dimensional acoustic section, hence echo is represented as a dot on the screen rather than a spike.In high myopic eyes it can be used to evaluate the posterior segment which can have retinal detachment, retinal tears. Posterior staphyloma is seen as a shallow excavation of the posterior pole with smooth edges on sonographic evaluation of highly myopic eyes.

8 **Optical coherence tomography –** A new diagnostic technology which provides a cross sectional image of the retina in vivo with a high resolution similar to histological section by a light microscopy. OCT can be used to diagnose a foveal retinal detachment with retinoschisis which are common features in severely myopic eyes with posterior staphyloma.

MANAGEMENT

Treatment of pathologic myopia may be divided into 3 goals – visual rehabilitation of the patient, prevention of myopic progression and the management of a variety of complicating diseases.

Visual rehabilitation

Optical :

Spectacles – patients should be advised about the type of frame and the material of the lenses which are suitable for those patients with high myopia. High-index glass, plastic and polycarbonate lenses are suitable for high myopic patients.Special edge polishing and buffing can also improve lens cosmetics.

Contact lenses – contact lenses are of special value in high myopia because they afford a dramatically improved appearance and enhance the visual acuity by reducing the image minification and expand the visual field. Both soft and gas-permeable contact lens designs are plausible.In cases of high myopia, it may be necessary to specify a minus-edge lenticular design to minimize the complications and discomfort of a thickened skirt.

Surgical :

Surgical correction of high myopia can be attempted through ,

1. The flattening of corneal curvature for lower degrees.
2. Insertion of IOL into the phakic anterior chamber.
3. The removal of clear crystalline lens.
4. Shortening of axial diameter by scleral resection.
5. Role of LASIK in high myopia is controversial.

Low vision aids – in cases of high myopia, the most useful low vision aid for distance is use of telescopic lens. New models with a small telescopic lens fitted into patients spectacles may be of great use.

Ocular hygiene :

Ocular hygiene has undoubtedly greatly emphasized as an adjunct to the control of myopic progression.

MANAGEMENT OF COMPLICATIONS

1. Retinal breaks and detachment

Treatment of retinal breaks is much rewarding than is, the attempted repair of an advanced detachment. **Yanoff** has recommended the use of cryo retinal ablation prophylactically. **Bensen & et al** advised treating an adequate margin of retina surrounding the lattice areas and

then carrying out the treatment of ora.Retinal detachment surgery should be done taking into consideration of factors of scleral thinning and posterior staphyloma.

1. **Choroidal neovascular membrane**

a)	Extra foveal CNVM (≥200µm from centre of FAZ)	–	Green 514nm / Red 647 nm laser to cover CNVM.
b)	Juxta foveal CNVM (<200µm & ≥ 1µm from centre of FAZ)	–	Laser to cover CNV contigous blockage and 100 m beyond on non foveal side
c)	Sub foveal	–	Photodyanamic therapy

2. **Ocular hypertension and glaucoma management**

The goal of glaucoma treatment is to preserve good visual function for the patients life time.This can be attained by lowering the intraocular pressure to a level that will stop or atleast slow the progression of optic nerve damage and its consequent vision loss. (**Blach et al).**

3. **Management of cataract**

Either phacoemulsification or SICS with proper IOL implantation has to be done taking proper precautions to prevent complications.

4. **Management of strabismus and amblyopia**

Early squint correction is accepted as the most beneficial approach to congenital tropias associated with myopia**(Taylor).** Appropriate spectacles and occlusion therapy is advocated to manage amblyopia.

5. Management of retinitis pigmentosa

Low vision aids and genetic counselling.

6. **Newer modality of treatment** - intravitreal injection of Bivacizumab seems to be an effective and safer treatment for macular CNVM. **(Sakaguchi, Ikumo) BJO, 2006 Aug 16.**

PART II

Aim of the Study

AIM OF THE STUDY

1. To analyze the clinical features and biometric parameters in pathological myopia.
2. To analyze the visual parameters in relation to posterior polar changes and disc changes.
3. To study the incidence of retinal degenerations and detachment in pathological myopes.
4. To analyze the association of other ocular association like lens changes, open angle glaucoma, retinitis pigmentosa, strabismus in cases of pathological myopia.

Materials and methods

MATERIALS AND METHODS

This study was carried out at Retina clinic, Regional Institute of ophthalmology and Government ophthalmic hospital Chennai from December 2004 to September 2006 . This is a prospective study.Cases were registered, evaluated, treated and followed up during the study period.

Inclusion criteria :

a. Patients with a refractive error of > 6.00 D.
b. Patients with normal corneal curvature.
c. Patients with axial length of > 24 mm.

Exclusion criteria :

a. Patients with index myopia.
b. Patients with abnormal corneal curvature.(curvature myopia were excluded).
c. Low degrees of myopia and congenital myopia.
d. Other ocular pathologies like micro ophthalmos, ROP, ectopia lentis were excluded.

Study design :

Myopic patients attending the RIO GOH - OPD between the period December 2004 to September 2006 were selected randomly – criteria applied.

1. History of refractive error including
   - duration
   - age at which spectacle were worn for the first time
   - time of last change of spectacles
   - complaints with present spectacles.
- Family history of myopia.

2. History of other symptoms like progressive loss of vision, defective vision related to day or night, sudden loss of vision, flashes and floaters.

All of them were subjected to routine ophthal examination including refraction and detailed fundus examination with drawing and were documented.

Anterior segment SLE was done to rule out other pathology. Routinely IOP was measured by applanation tonometer for all the patients. The axial length was measured using Ascan biometry and keratometer was done. Those with abnormal K- reading were excluded from the study.Visual acuity recorded & improvement with glasses noted.

Those patients with posterior pole changes were picked up for further investigations. Patients with macular pathology were followed up with FFA and documented. Those with posterior staphyloma were confirmed with B scan. The incidence of various degenerations were recorded and analyzed , evaluated and treated accordingly. Those patients who presented with complications as well as who had complications during the study period were treated accordingly. Those with retinal tears were treated with barrage LASER and also with anterior retinal cryopexy. And all were followed up periodically.

Observation & Analysis

OBSERVATION & ANALYSIS

1) ANALYSIS DEPENDING ON AGE

Age in	Number of patients	Percentage
0 -10	3	6%
11-20	15	30%
21-30	19	38%
31-40	7	14%
41-50	4	8%
>50	2	4%

Incidence of pathological myopia was common in the age group of 21 to 30 years,i.e in young adults which correlated well with **Framingham Eye study group.**

2) ANALYSIS DEPENDING ON SEX

Sex of patient	No of patients	Total %
Female	27	54%
Male	23	46%

Sex appears to have an influence on incidence. Females are prone to higher degrees and to degenerative changes of pathological myopia myopia**. (Arun verma et al)**

3) ANALYSIS DEPENDING ON OCCUPATION

Occupation	Number of patients	Percentage
Student	26	52%
House wife	8	16%
Engineer	5	10%
Teacher	2	4%
Clerk	3	6%
Labourer	3	6%
Others	3	6%

Majority of patients in this study were from student community.

4) ANALYSIS DEPENDING ON FAMILY HISTORY

Total No of cases	**50**
No of cases with family history	9
Percentage	18%

Out of 50 cases examined only 9 cases (18%) had positive family history, and this can be attributed to lack of awareness mainly in low socioeconomic group.

5) ANALYSIS DEPENDING ON EYES INVOLVED

Eyes involved	Total	Percentage
Unilateral	4	8%
Bilateral	46	92%

Out of 50 cases of pathological myopia 46 had bilateral presentation and only 4 persons had unilateral occurrence.

6) ANALYSIS DEPENDING ON UNCORRECTED VISUAL ACUITY

Visual acuity	Number of eyes involved	Percentage
6/60 – 4/60	33	34.37%
4/60 – 2/60	35	36.45%
2/60 – 1/2/60	17	17.70%
HM/CFCF/PL	11	11.45%

Out of 96 eyes studied majority of patients had an uncorrected visual acuity ranging from 4/60 to 2/60 which was closely followed by 6/60 to 4/60 group.

7) ANALYSIS DEPENDING ON REFRACTIVE STATUS

Refractive status	Number of eyes	Percentage
-6 to -10 D	35	36.45%
-10 to -14 D	31	32.29%
-14 to -18 D	7	7.29%
-18 to -22 D	7	7.29%
> - 22 D	3	3.12%

Among 50 patients nearly 80 % of study group had refractive error ranging from -6.0 D to – 14.0 D .

8) ANALYSIS DEPENDING ON BEST CORRECTEDVISUAL ACUITY

BCVA	Number of eyes	Percentage
6/6 – 6/18	18	18.75%
6/18 – 6/36	35	35.41%
6/36 – 6/60	23	23.95%
6/60 – 1/60	7	7.29%
<1/60	13	13.45%

About 35% of the patients had a best corrected visual acuity of 6/18 to 6/36, after proper retinoscopy and refraction. Vision correction in high myopic eyes is obviously decreased with increase in dioptres.

9.**ANALYSIS DEPENDING ON AXIAL LENGTH**

Axial length (in mm)	**Number of eyes**	**Percentage**
24 – 26	7	7.29
26 – 28	59	61.45
28 – 30	22	22.91
30 – 32	8	8.33

Majority of eyes included in the study had an axial length ranging between 26 mm to 28 mm**.(Lin L.L, Shih. Y.F,Lee.Y.L).** Axial elongation of the eyeball is the main component in myopic progression.

10) ANALYSIS DEPENDING ON INTRAOCULAR PRESSURE

IOP	Number of eyes	Percentage
< 10	4	4%
10 – 12	5	5%
12 – 14	30	30%
14 – 16	30	30%
16 – 18	21	21%
18 – 20	6	6%
> 20	4	4%

Out of 96 eyes in the study group, about 4% had an ↑ed IOP of more than 20mm of Hg by applanation tonometry.Nearly 80% patients in this study had a normal IOP.

11) ANALYSIS OF VITREOUS PATHOLOGY

Vitreous pathology	Number of eyes.	Percentage
Vitreous fibrillations and strands	22	22.91%
PVD	14	14.58%

About 20% of pathological myopia presented with vitreous strands and fibrillation and 14% with PVD indicating more than 50% had vitreous pathology at the time of presentation itself (**Morit H et al).**

12) ANALYSIS DEPENDING ON VARIOUS RETINAL CHANGES IN THE POSTERIOR POLE

Retinal changes	Number of eyes	Percentage
Posterior staphyloma	10	10.41%
Temporal crescent	44	45.83%
Tigroid fundus	47	48.94%
Peripapillary atrophy	33	34.37%
CRAP	28	29.16%

SRNVM	5	5.20%
Lacquer cracks	2	2.08%
Forster fuchs spots	4	4.16%
Bony spicules	10	10.41%
Medullated nerve fibre	1	1.04%
Retinoschisis	1	1.04%
Macular Pigmentary stippling	3	3.12%

Majority of the patients in this study group had temporal crescent and tigroid fundus as a common feature.10% of the patients had posterior staphyloma. Lacquer cracks were seen in 2% of the patients .Forster fuchs spots were seen in 4% of the patients. Chorio retinal atrophic patches were seen in 29% of the patients which correlated well with the study conducted by **Brasil et al**. SRNVM was seen in 4% of the patients which is in concordance with the study conducted by **Ohno-Matsui K**

13) ANALYSIS OF RETINAL CHANGES IN PERIPHERY

Retinal changes	**Number of eyes**	**Percentage**
Lattice degeneration	13	13.54%
Paving stone degeneration	10	10.41%
WWOP	9	9.37%
Snail track degeneration	5	5.20%
Retinal tear	2	2.08%

Lattice degeneration was the commonest type of peripheral degeneration noted in the study , followed by paving stone degeneration, which coincides well with the study by **Celorio , Preutt R C.**

14) ANALYSIS OF OTHER OCULAR FINDINGS

Condition	Number of eyes	Percentage
RP	10	10.41%
Retinal detachment	9	9.37%
Postr subcapsular cataract	8	8.33%
SRNVM	5	5.20%
POAG	4	4.16%
Strabismus	2	2.08%
Retinoschisis	1	1.04%

Higher incidence of Pigmentary dystrophy (10.4%) was noted in the study group, followed by RD (9.37%).Other associations noted were Posterior sub capsular cataract. (Beaver Dam eye study), increased intra ocular pressure (Blue mountain study) and strabismus(2%)..

15) CONDITIONS PREDISPOSING TO RETINAL DETACHMENT

Peripheral degenerations	Number of eyes	Percentage
Lattice degeneration	11	11.45%
Snail track degeneration	6	6.25%
White without pressure	9	9.37%
Retinal tears	2	2.08%

Lattice degeneration with hole was commonest among the predisposing factors for retinal detachment, followed by white without pressure.

16) ANALYSIS DEPENDING ON CONDITIONS NOT PREDISPOSING TO RETINAL DETACHMENT

Condition	Number of eyes
Paving stone degeneration	11
Percentage	11.45%

Paving stone degeneration was the 2nd common degeneration noted in the study.

17) ANALYSIS DEPENDING ON K READING

K Reading	Number of patients	Percentage
44 – 45	29	30.20%
45 – 46	25	26.04%
46 – 47	32	33.34%
47 – 48	10	10.41%

The corneal curvature in this group was in the normal range as those with a higher curvatures were excluded**.**

18) ANALYSIS DEPENDING ON LATTICE DEGENERATION IN DIFFERENT QUADRANTS .

Quadrant	Number of eyes	Percentage
Supero Temporal	7	63.30%
Supero Nasal	1	9.09%
Infero Temporal	1	9.09%
Infero Nasal	2	18.18%

Lattice degeneration was most commonly located in the supero – temporal quadrant (63.3%).

19) ANALYSIS OF INCIDENCE OF RETINAL DETACHMENT IN DIFFERENT MYOPIC STATUS

Diopteric power (in spheres)	Number of patients	Percentage
<10 D	3	30%
>10 D	7	70%

Among the RD cases, patients with less than 10 dioptres had 30% incidence of RD, where as those with more than 10 dioptres had 70 % incidence of RD.This indicates that the risk for RD increases with the increase in diopteric power

Discussion

DISCUSSION

- 96 eyes of 50 patients with pathological myopia were studied, of which its incidence was common between the age group 21 to 30 years , which correlated well with Framingham Eye study group , suggesting that aging in addition to mechanical stretching is also important for the development of the fundus changes.

- Sex appears to have an influence on incidence. Females are more prone to higher degrees of myopia as well as degenerative changes occurring in high myopia.

- Only 8%of cases had family history of myopia , majority of the cases did not have a significant family history. Reduced incidence may be due to lack of awareness among the low socio economic group.

- Majority of patients in this study were from student community which suggests that those people are more aware of their refractive error and seek ophthalmic opinion earlier.
- Out of 50 cases of pathological myopia 46 had bilateral presentation and only 4 persons had unilateral occurrence. In cases of unilateral myopia good prognosis for mono ocular visual

acuity as well as binocular vision is expected if timely and consistent therapy is administered.

- Nearly 80% of patients with myopia fell into the dioptric range of - 6 to -14 D, which indicates that extreme degrees of myopia is relatively less frequent and suggests that greater the dioptre is, harder the vision can be ideally corrected.

- Majority of eyes included in this study has an axial length ranging between 26 – 28mm (**Liull et al**), which shows that axial elongation of the eye ball is the main component causing myopic progression.

- Among the study group, about 4%had an elevated IOP of more than 20 mm Hg by applanation tonometry (**Blue mountain study group**).

- Out of 96 eyes even after full correction with glasses, in majority of them (36%) BCVA improved to only 6/18 to 6/36, which shows that the higher the diopteric power , the harder the vision

can be ideally corrected.The greater the pathologic changes at the posterior pole , the severer the degree of damage(**Journal Eye Science: 2003 Dec 19(4) 211 – 4)**

- More than 50% of cases in this group had vitreous abnormalities which suggests that liquefaction of the vitreous begins at an earlier age in patients with high myopia and progresses with age and axial elongation and thus results in a frequent occurrence of PVD(14%)-**Morita h,Funata M et al Retina 1995 15(2):117-24.**

- Majority of patients in this study group had temporal crescent and tesselated fundus as a common feature followed by Posterior staphyloma- 10%,SRNVM – 5.20%, Forster Fuchs spots – 4.16% and Lacquercracks–2.08%, which correlates well with the study conducted by **Brasil et al (Arq.Bras Ophthal Mar-April,69(2) 203-6).**

- Lattice degeneration was the commonest type of peripheral degeneration noted (**Celorio J M et al**).The prevalence of lattice

degeneration is influenced by the amount of axial elongation in highly myopic eyes.(**Amj : 1991 Jan 15 (11) 1:20:3).**

- a) Myopic patients had higher risk of glaucoma compared with that of non myopic subjects(**Ophthalmology 2000 Jun 107(6) 1026-7 -The blue mountain study**).

  b) Other associations noted were Posterior subcapsular cataract **(Lim et all)** ,Strabismus , Retinitis pigmentosa and Retinal detachment.

- Among the predisposing factors leading to RD, lattice with hole was the leading factor followed by paving stone degeneration. Among the number of lattice degeneration noted majority of them were seen in the supero temporal quadrant probably due to excessive stretching and increased vascularity in this area.

- Patients with refractive status of more than 10 D showed a higher risk of RD , showing that the risk of RD is directly proportional to the higher degrees of myopia (ie, axial lengthening).
- Hence this study demonstrates that the fundus findings in moderately to high myopic patients were prominent in the

posterior pole. This information may be useful when evaluating and following patients with moderate to high degrees of myopia especially after surgical refractive modification.

Summary

SUMMARY

- 96 eyes of 50 patients with pathological myopia were analysed based on their axial length, corneal curvature and ocular fundal changes at the posterior pole and in the peripheral retina

- Highest incidence of pathological myopia was noted in the age group between 21 – 30 yrs

- The majority of patients did not have significant family history. 8% had unilateral myopia on presentation.

- Majority of patients in my study were found to be students which says that the most common environmental factor could be increasing education & higher amounts of near work.

- About 70% of the patients had an UCVA ranging between 2/60-6/60.

- 80% of the patients with pathological myopia fell into the dioptric range between – 6 to -14 dioptres. Very high degrees of pathological myopia were less frequent.

- High degree of myopia had a definite correlation with increase in axial length.

- The higher the refractive power the more difficult is to achieve a near normal vision, which establishes the fact that pathological changes in the posterior pole is responsible for the defective vision.

- More than 50% of the cases showed vitreous abnormalities showing the early onset of vitreous degeneration in high myopes.

- Lattice degeneration was the commonest type of peripheral degeneration noted and was seen mostly in the super temporal quadrant.

- Majority of the patients had temporal crescent and tessellated fundus as a common feature.
- Posterior staphyloma was seen in 10% eyes.

- About 2% of eyes showed lacquer cracks and Forster Fuchs spots was seen in 4.16% of eyes.

- Choroidal neovascularisation was seen in 5% eyes.

- Retinitis pigmentosa, retinal detachment, glaucoma, posterior subcapsular cataract were the common ocular associations seen in high myopic patients.

- Hence this study brings forth the various factors that may be useful while evaluating & following up of patients with moderate to high degrees of myopia.

Conclusion

CONCLUSION

Pathological myopia is a complex eye disease in which the patients not only present with visual morbidity but also have a diseased eye. Hence they have to be approached according to their needs & presentations.

Degenerative changes are more commonly seen in higher degrees of myopia & so all cases of myopia must be examined meticulously with indirect ophthalmoscope which can pick up complications at the earliest & can be treated effectively. This can aid in retaining useful ocular function. Awareness need to be created among myopic population regarding visual hygiene, safety precautions, risks & complications involved.

They have to be informed about the warning signs & symptoms to report early for better management. hence all patients with pathological myopia should be monitored periodically.

Genetic counseling & low vision aids are advised whenever necessary.

PART III

Proforma

PROFORMA

1 . Case N o : Hospital No :

2. Name :

3. Age : Sex :

4. History :

Defective vision : Day / Night

Floaters :

Flashes :

Wearing spectacles since :

Last change of spectacles :

Family H/O myopia :

5. General Examination :

6. Systemic Examination :

7. Local Examination :

	RE	LE
Vision :		
I.O.P :		
Retinoscopy :		
Best corrected visual acuity :		
Anterior Segment :		
A-Scan/ Keratometry :		
Fundus (Direct Ophthalmoscopy)		
Media :		

Disc/Cup :

Colour :

Size :

Cup :

Crescent :

Blood Vessels :

Macula :

Back Ground :

Indirect Ophthalmoscopy :

3 mirror contact lenses :

8. Observations :

Type of degenerations found

a. Pigmentary

b. Paving stone

c. Lattice

d. Chorio - retinal

e. White without pressure

f. White with pressure

g. Snail track degeneration

h. Retinal break

9 . Quadrants :

a. Supero Temporal

b. Supero Nasal

c. Infero Nasal

d. Infero Temporal

10 . Eyes :

a. Unilateral

b. Bilateral

11 . Retinoscopy :

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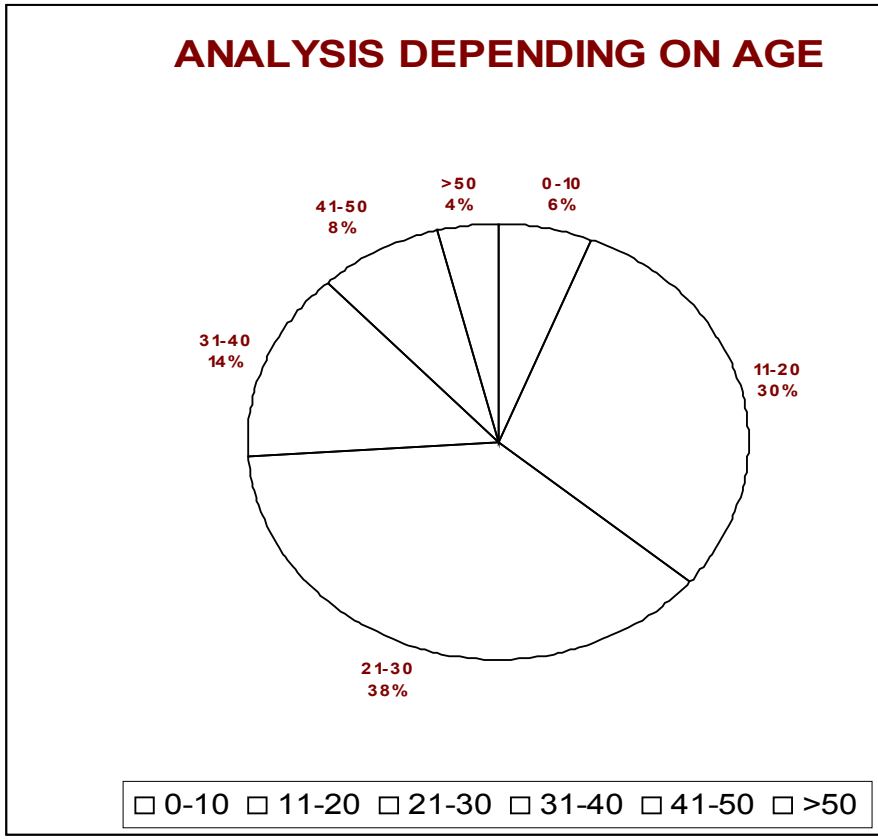
KEY TO MASTER CHART

F/H	-	Family History
VA	-	Visual Acuity
Ref. Power	-	Refractive Power
BC/VA	-	Best corrected/Visual acuity

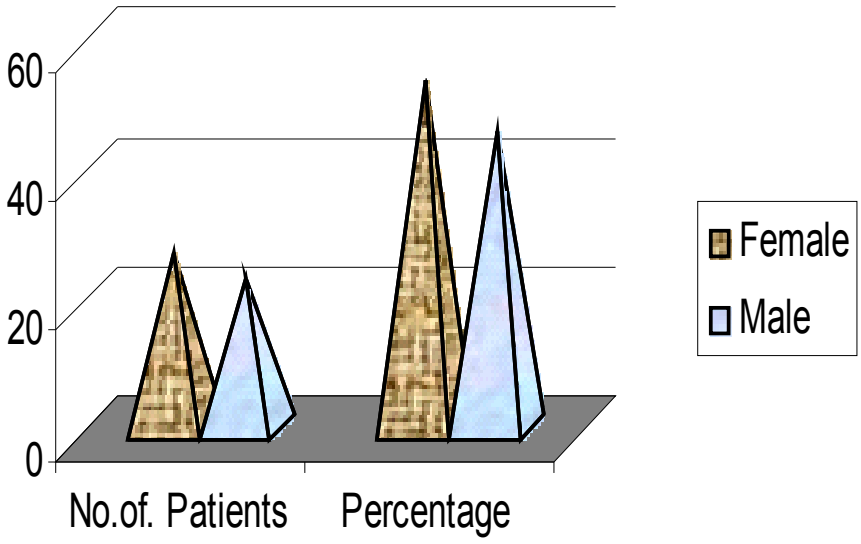
AL	-	Axial length
F.Changes	-	Fundus changes
RE	-	Right Eye
LE	-	Left Eye
Wnl	-	Within normal limits
VF	-	Vitreous floaters
Tess	-	Tesselation
Temp	-	Temporal
LD	-	Lattice degeneration
STD	-	Snail track degeneration
PSD	-	Paving stone degeneration
PVD	-	Posterior vitreous detachment
PS	-	Posterior staphyloma
RT	-	Retinal tear
RD	-	Retinal detachment
WWP	-	White with pressure
WWOP	-	White without pressure
STQ	-	Supero temporal quadrant
SNQ	-	Supero nasal quadrant
INQ	-	Infero nasal quadrant
ITQ	-	Infero temporal quadrant

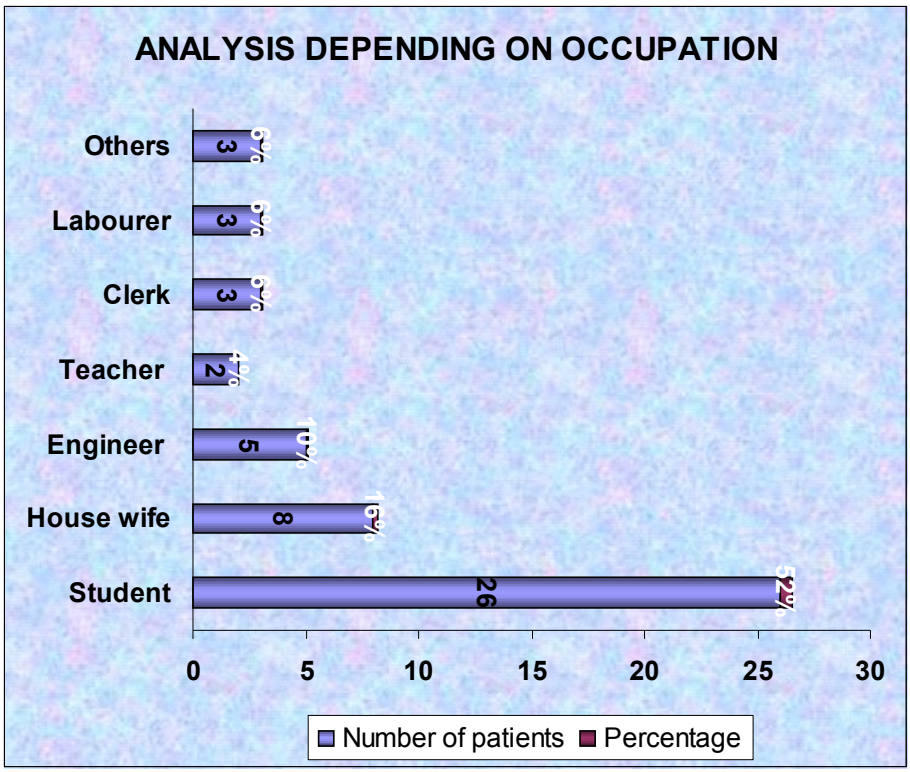
SQ	-	Superior quadrant
BG	-	Best glasses
EXP	-	Explant
Pro.Cryo	-	prophylactic cryotherapy
PR	-	Periodic review
PPC	-	Posterior polar cataract
CRAP	-	Chorio retinal atrophic patches.

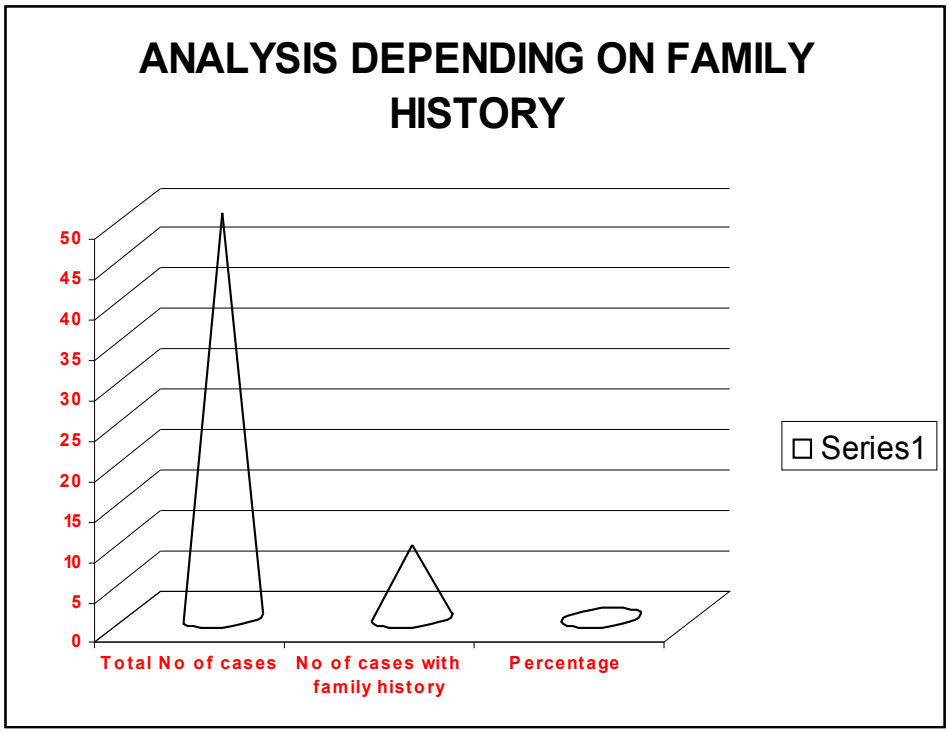
ANALYSIS DEPENDING ON AGE



ANALYSIS DEPENDING ON SEX




ANALYSIS DEPENDING ON OCCUPATION
Others
Labourer
Clerk
Teacher
Engineer
House wife
Student
3
3
3
2
5
8
26
0
5
10
15
20
25
30
Number of patients
Percentage


ANALYSIS DEPENDING ON FAMILY HISTORY
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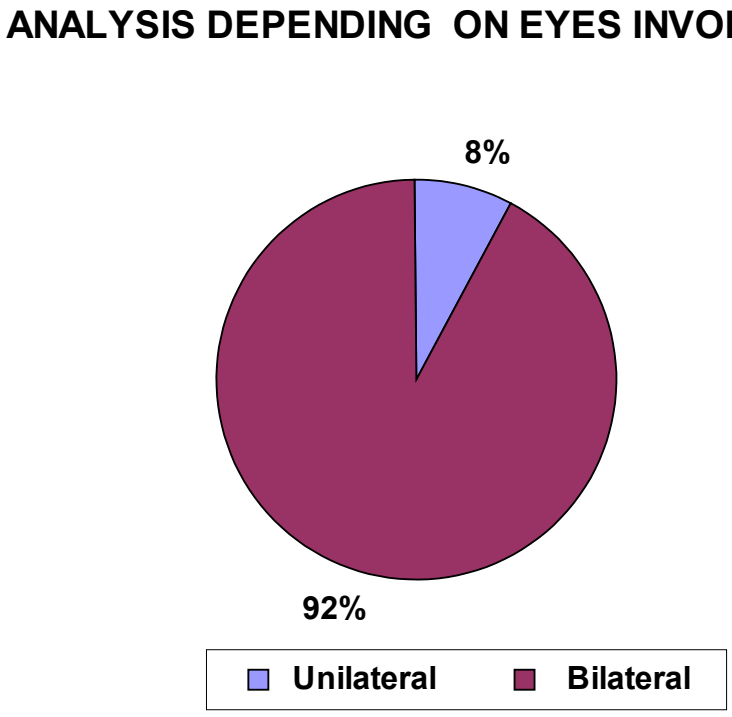
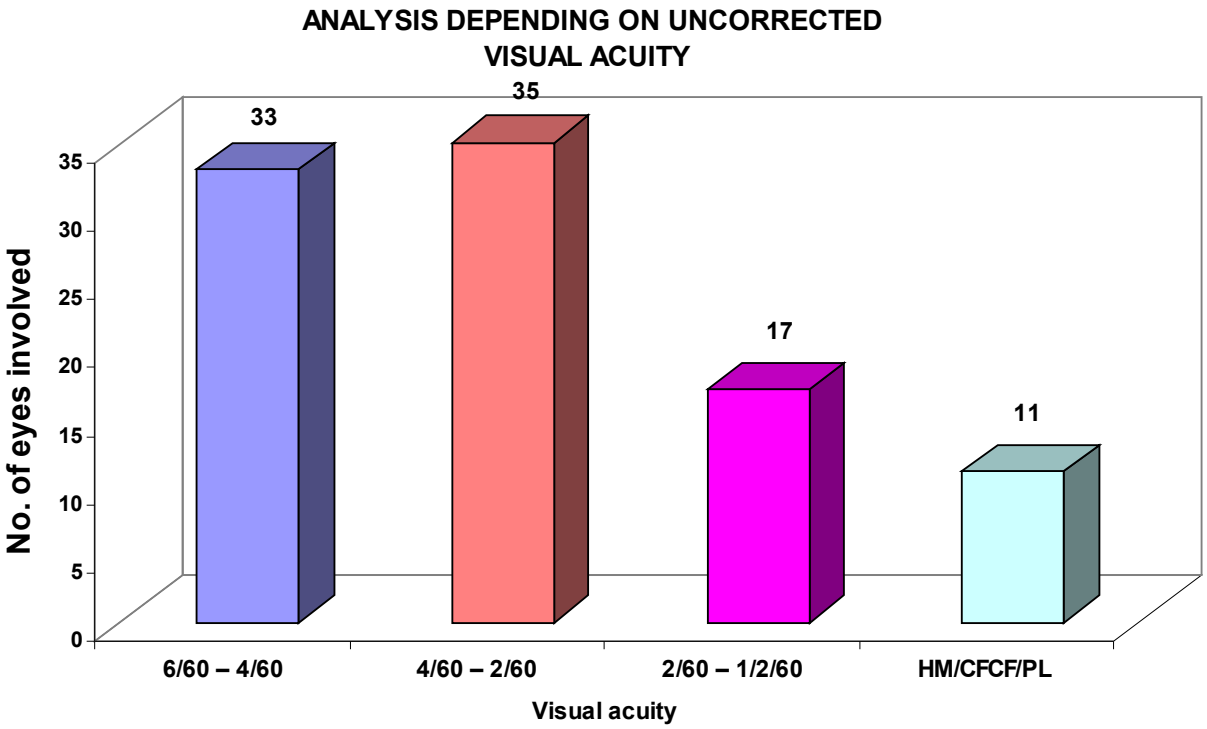
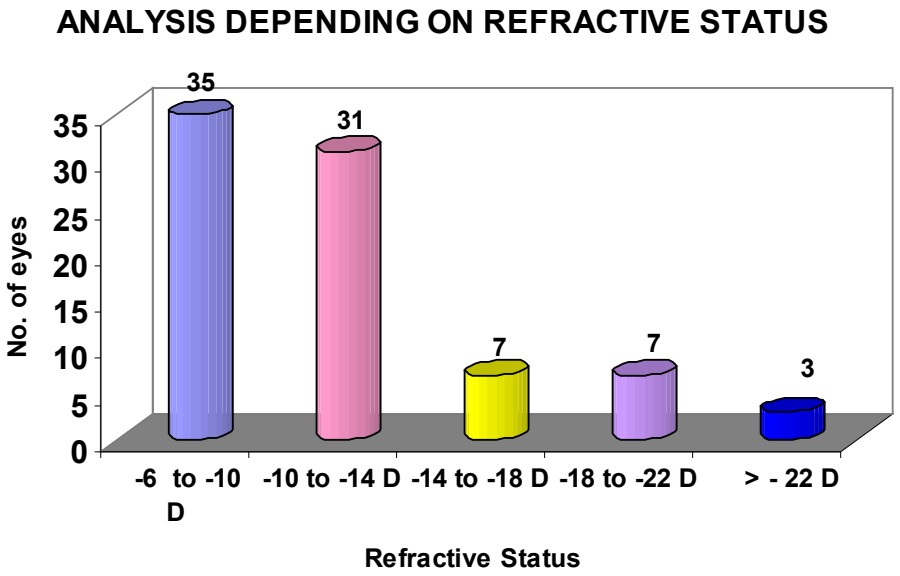
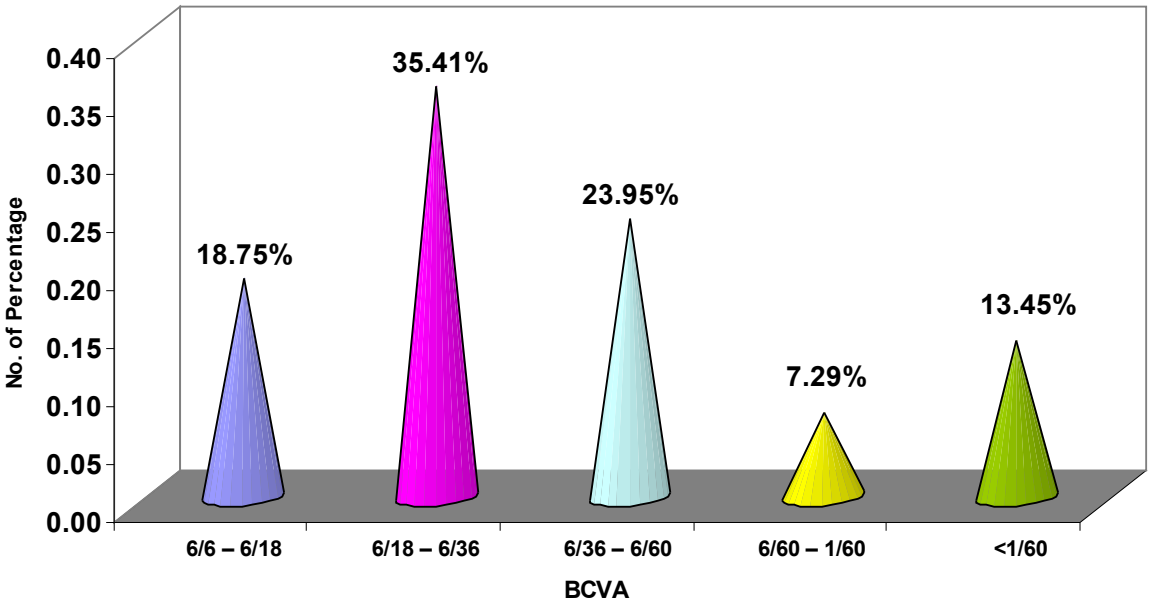
45
40
35
30
25
20
15
10
5
0
Total No of cases
No of cases with family history
Percentage
Series1


ANALYSIS DEPENDING ON EYES INVOLVED
8%
92%
Unilateral
Bilateral

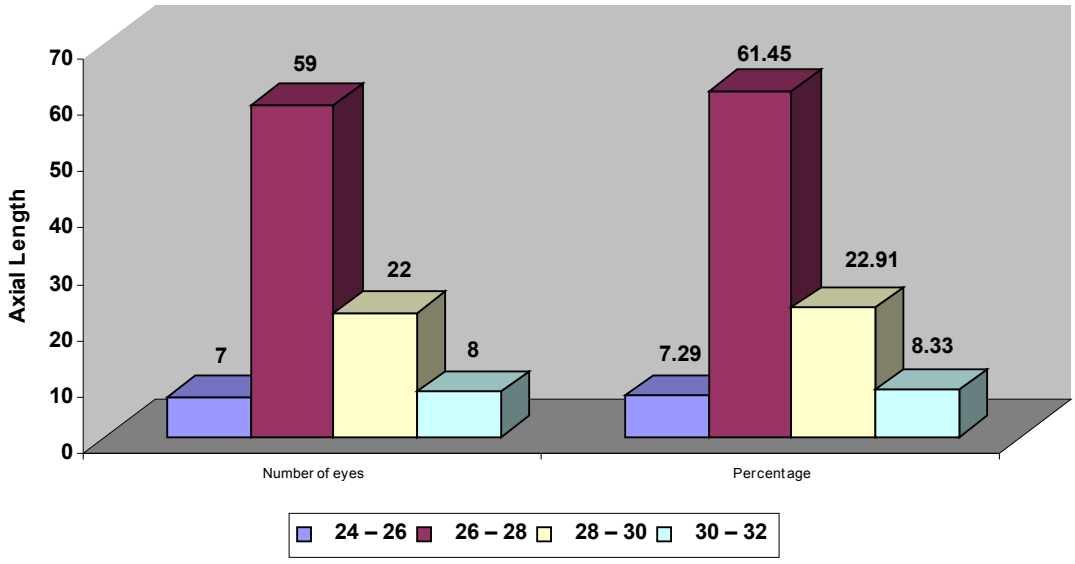

ANALYSIS DEPENDING ON UNCORRECTED VISUAL ACUITY
No. of eyes involved
0
5
10
15
20
25
30
35
33
35
17
11
6/60 – 4/60
4/60 – 2/60
2/60 – 1/2/60
HM/CFCF/PL
Visual acuity

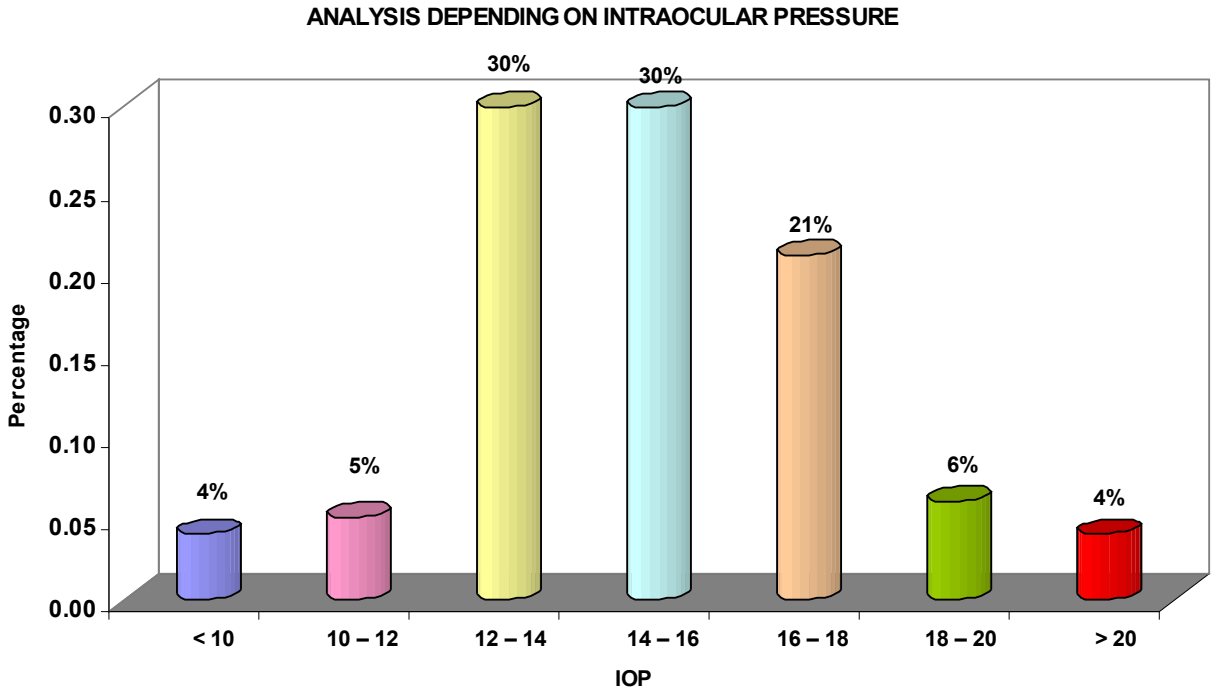

ANALYSIS DEPENDING ON REFRACTIVE STATUS
No. of eyes
0
5
10
15
20
25
30
35
35
31
7
7
3
-6 to -10 D
-10 to -14 D
-14 to -18 D
-18 to -22 D
> - 22 D
Refractive Status

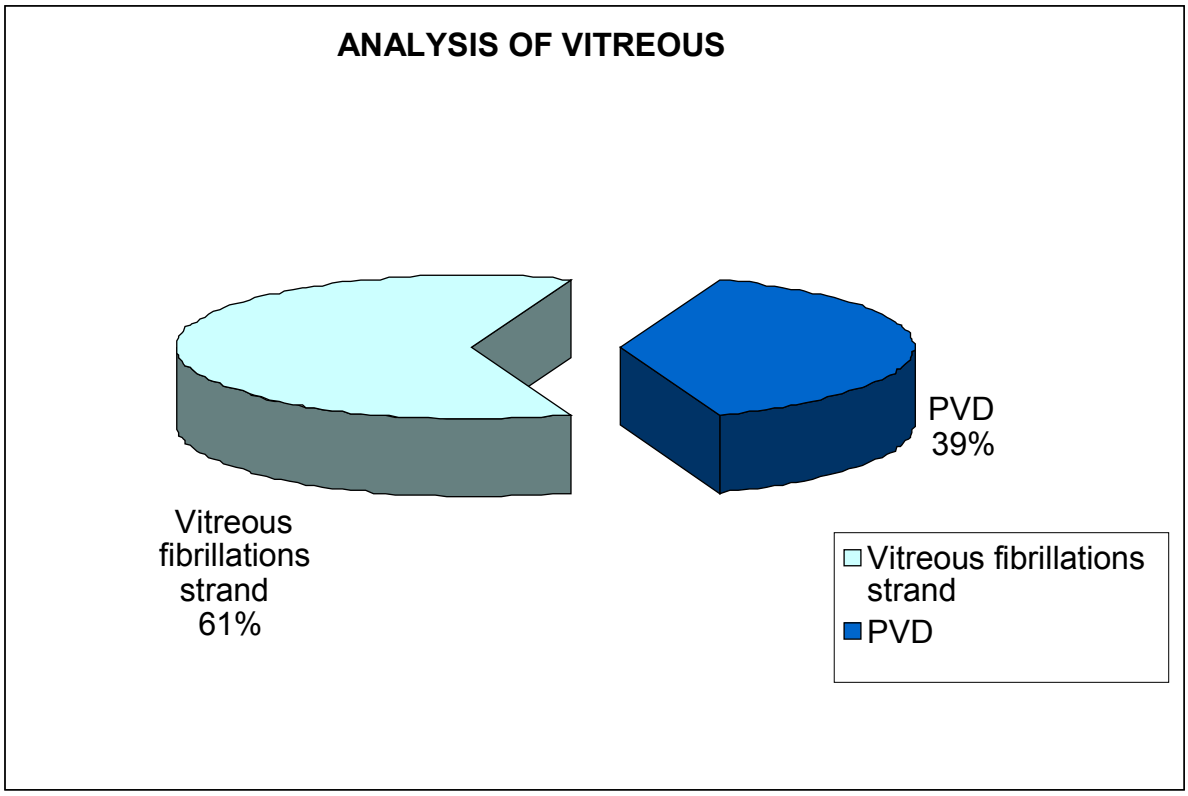
ANALYSIS DEPENDING ON BEST CORRECTEDVISUAL ACUITY

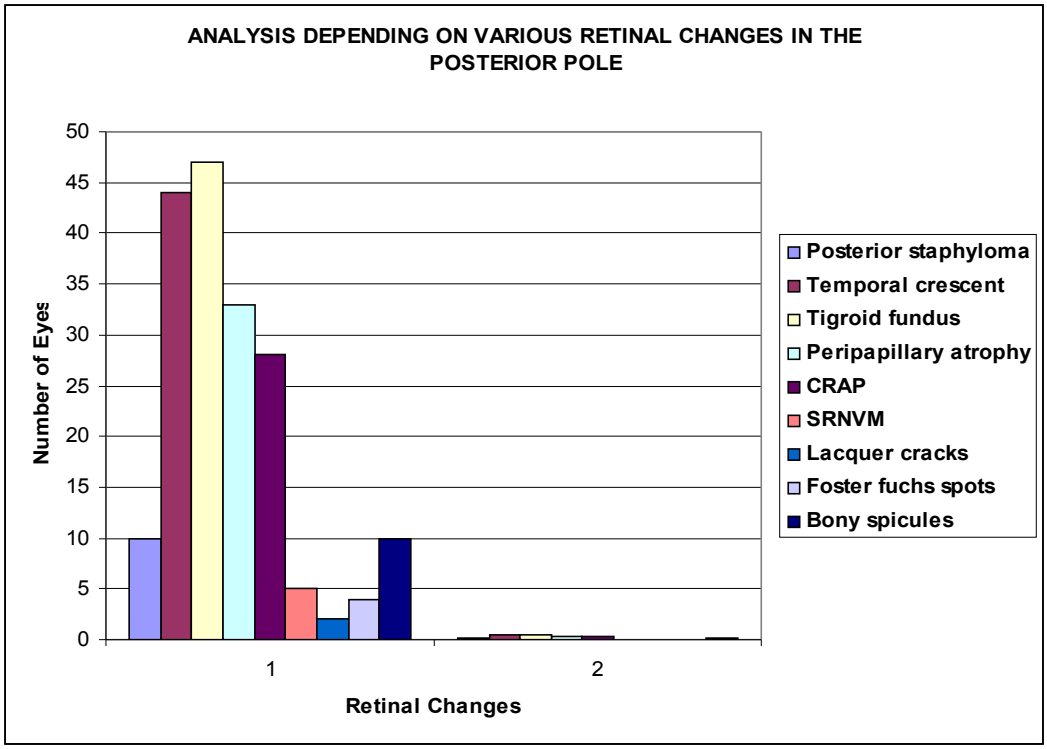


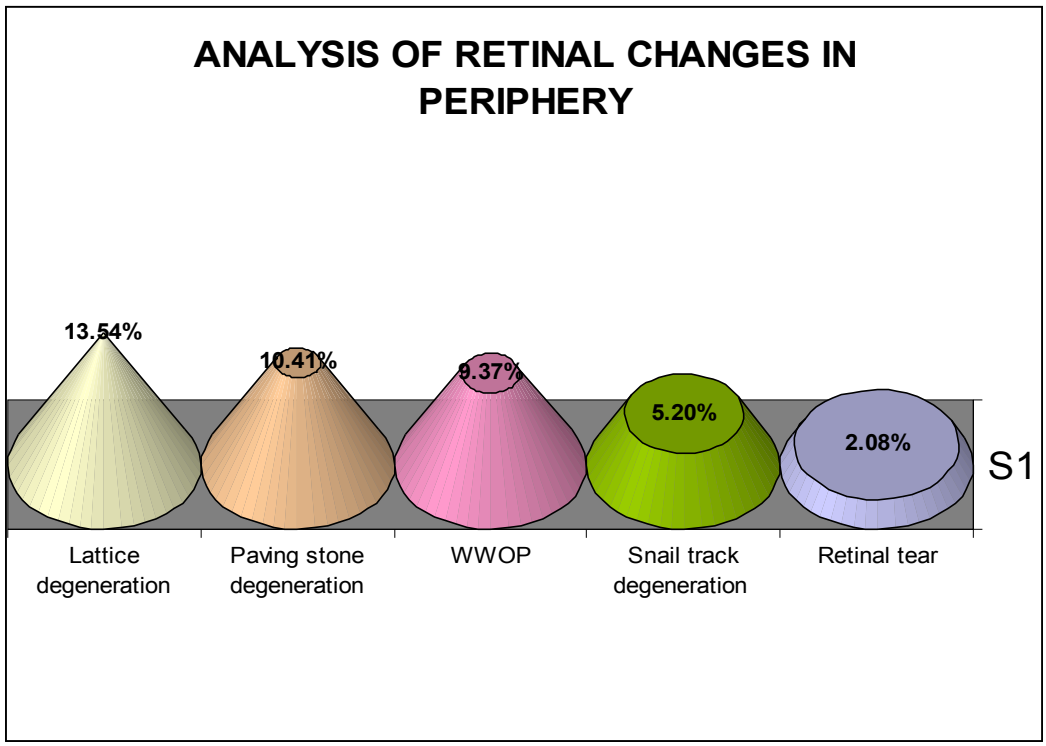
ANALYSIS DEPENDING ON AXIAL LENGTH

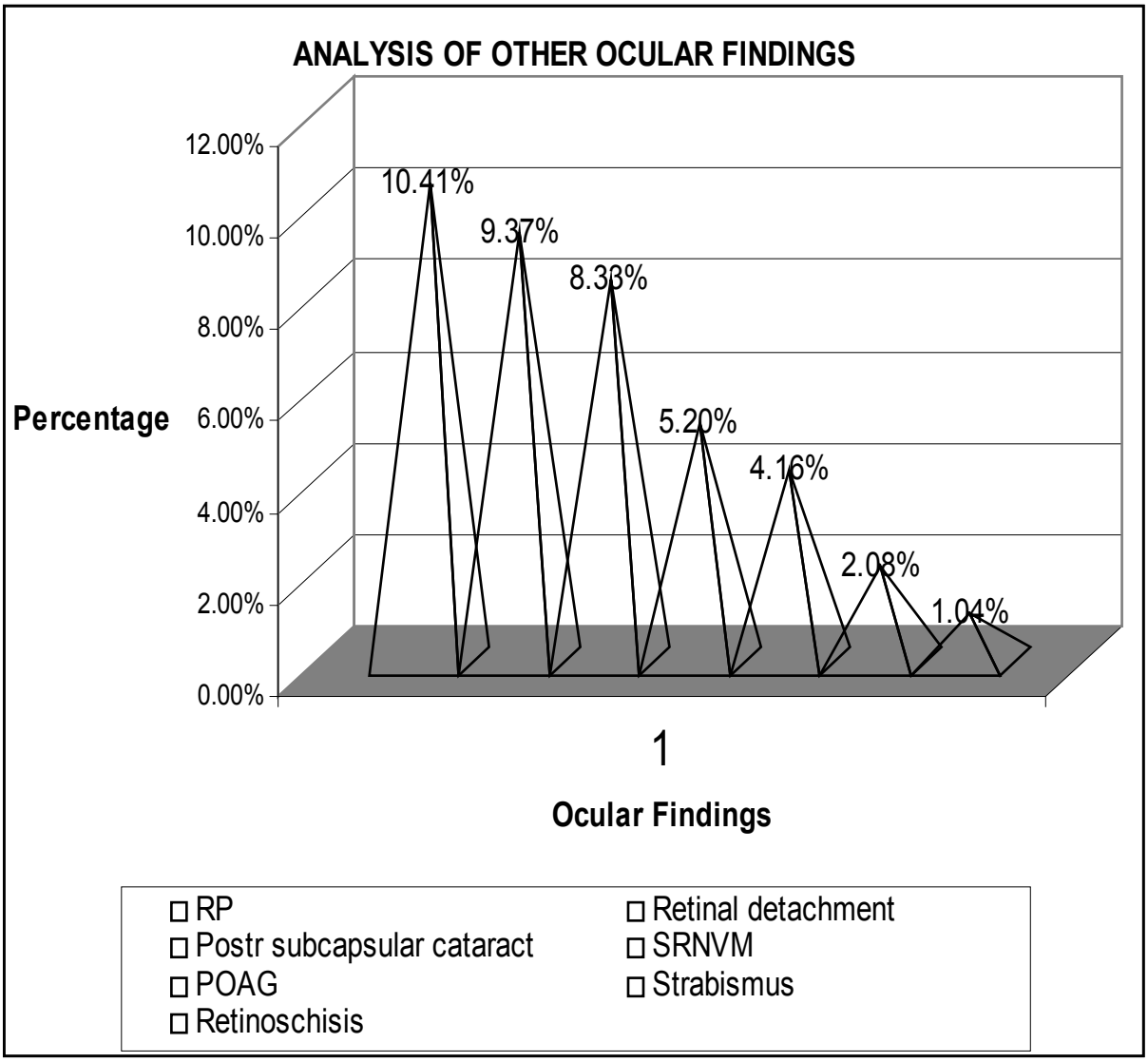


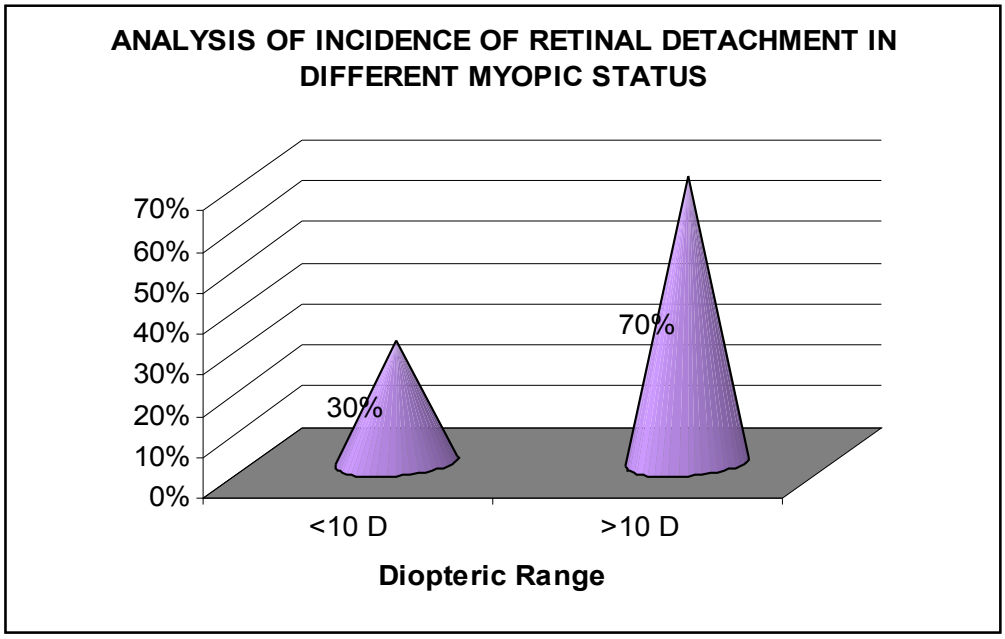

ANALYSIS DEPENDING ON INTRAOCULAR PRESSURE
Percentage
0.30
0.25
0.20
0.15
0.10
0.05
0.00
4%
5%
30%
30%
21%
6%
4%
< 10
10 – 12
12 – 14
14 – 16
16 – 18
18 – 20
> 20
IOP

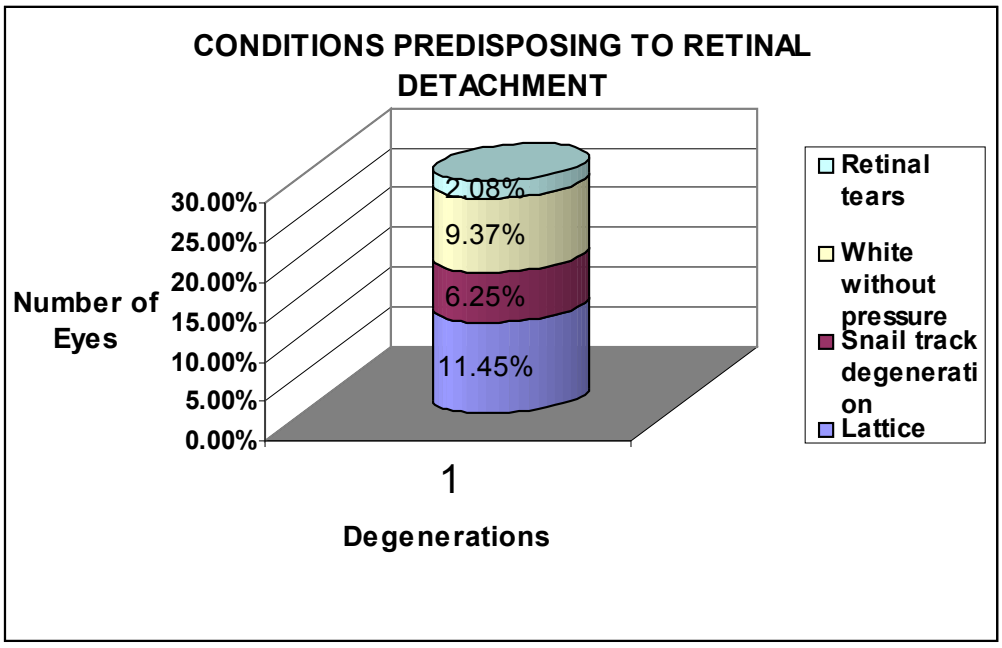

ANALYSIS OF VITREOUS
Vitreous fibrillations strand 61%
PVD 39%
Vitreous fibrillations strand
PVD


ANALYSIS DEPENDING ON VARIOUS RETINAL CHANGES IN THE POSTERIOR POLE
Number of Eyes
50
45
40
35
30
25
20
15
10
5
0
1
2
Retinal Changes
Posterior staphyloma
Temporal crescent
Tigroid fundus
Peripapillary atrophy
CRAP
SRNVM
Lacquer cracks
Foster fuchs spots
Bony spicules

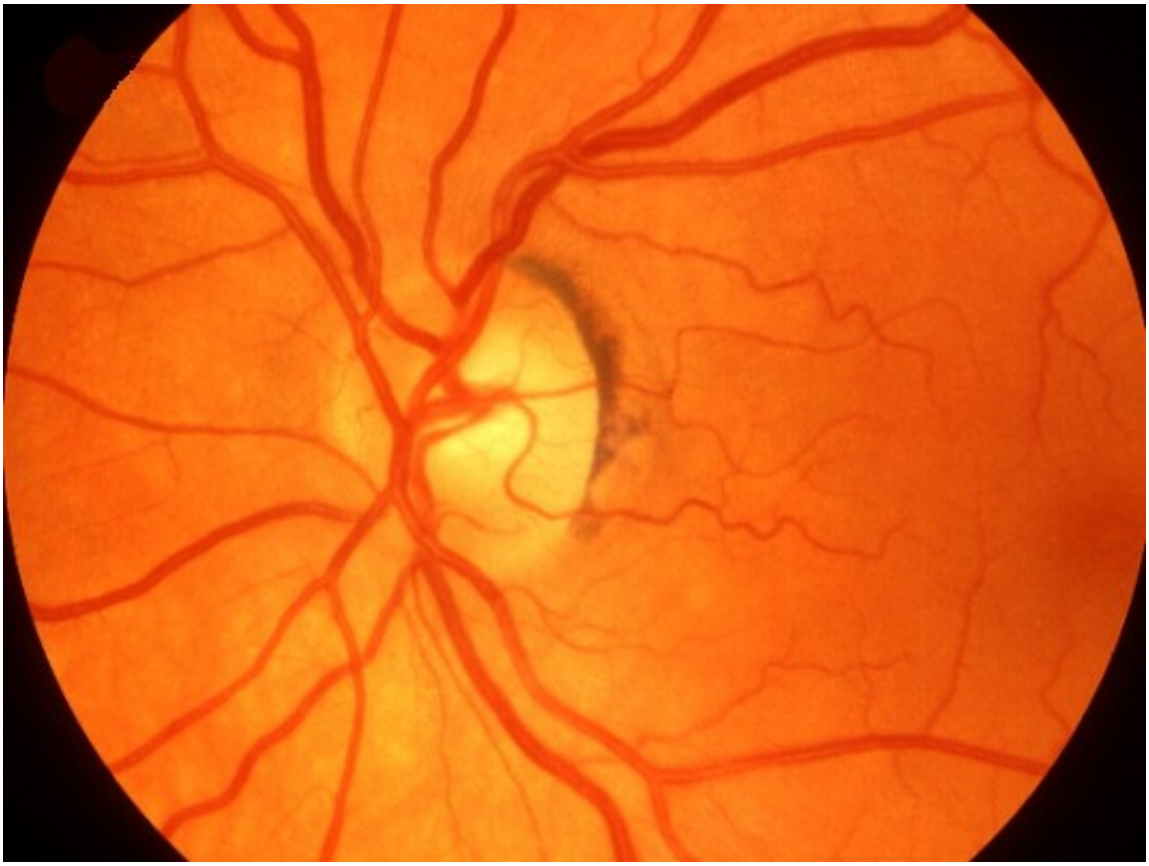

ANALYSIS OF RETINAL CHANGES IN PERIPHERY
13.54%
10.41%
9.37%
5.20%
2.08%
S1
Lattice degeneration
Paving stone degeneration
WWOP
Snail track degeneration
Retinal tear


ANALYSIS OF OTHER OCULAR FINDINGS
Percentage
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
10.41%
9.37%
8.33%
5.20%
4.16%
2.08%
1.04%
1
Ocular Findings
RP
Postr subcapsular cataract
POAG
Retinoschisis
Retinal detachment
SRNVM
Strabismus

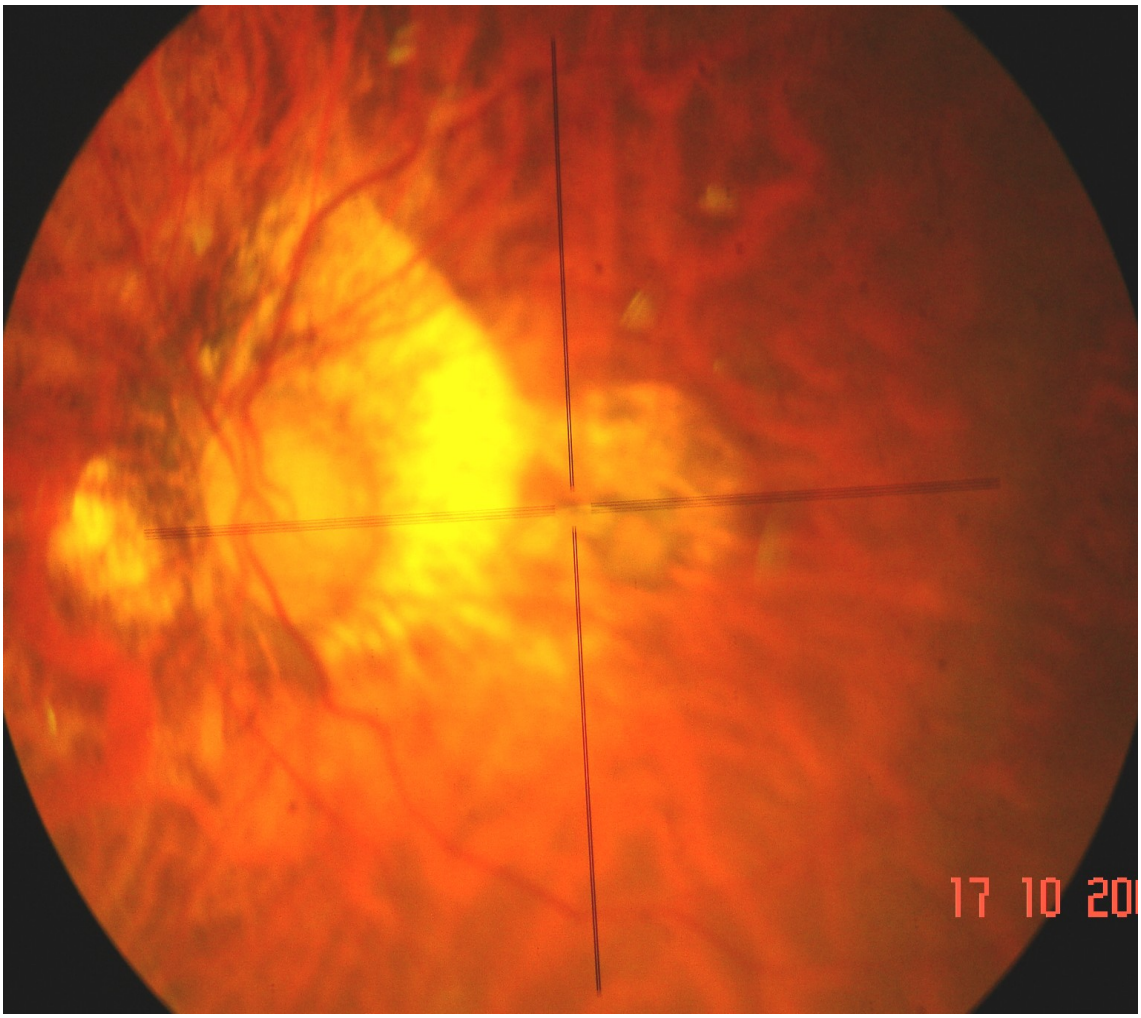

ANALYSIS OF INCIDENCE OF RETINAL DETACHMENT IN DIFFERENT MYOPIC STATUS
70%
60%
50%
40%
30%
20%
10%
0%
30%
70%
<10 D
>10 D
Diopteric Range


CONDITIONS PREDISPOSING TO RETINAL DETACHMENT
Number of Eyes
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
2.08%
9.37%
6.25%
11.45%
1
Degenerations
Retinal tears
White without pressure
Snail track degeneration
Lattice

Frans Cornelis Donders



Normal Fundus



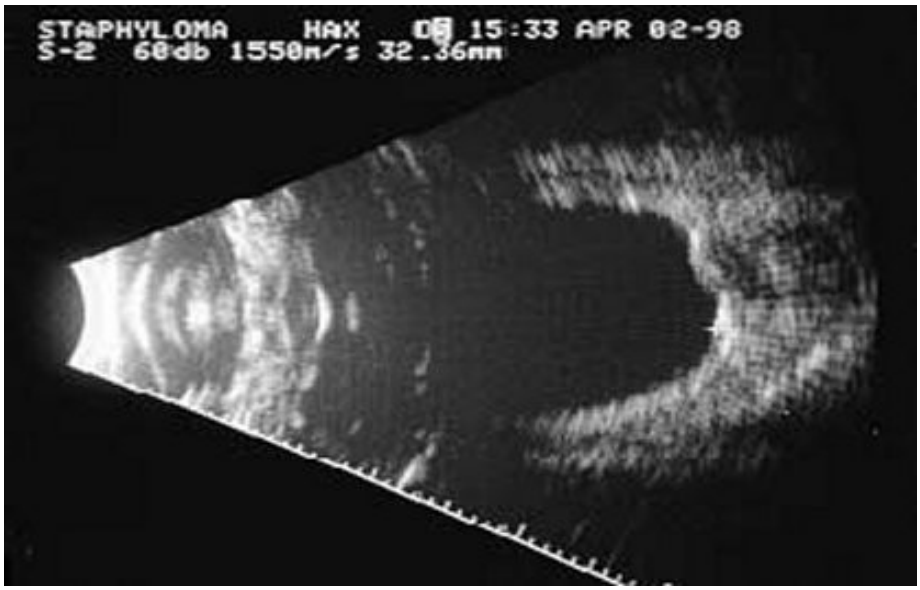
Tesselated Fundus

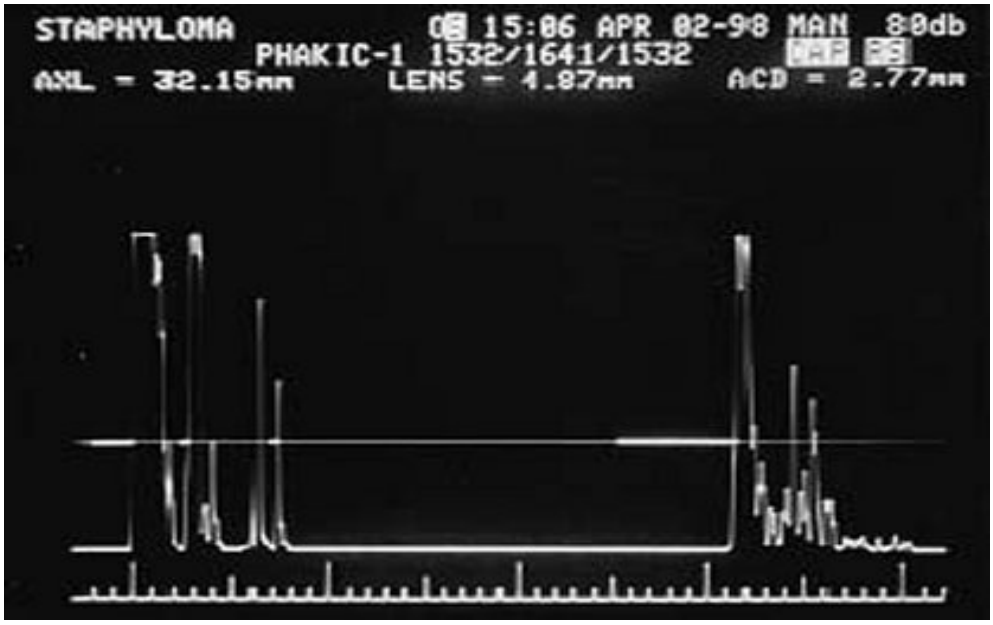
A scan Biometry

Retinal hole

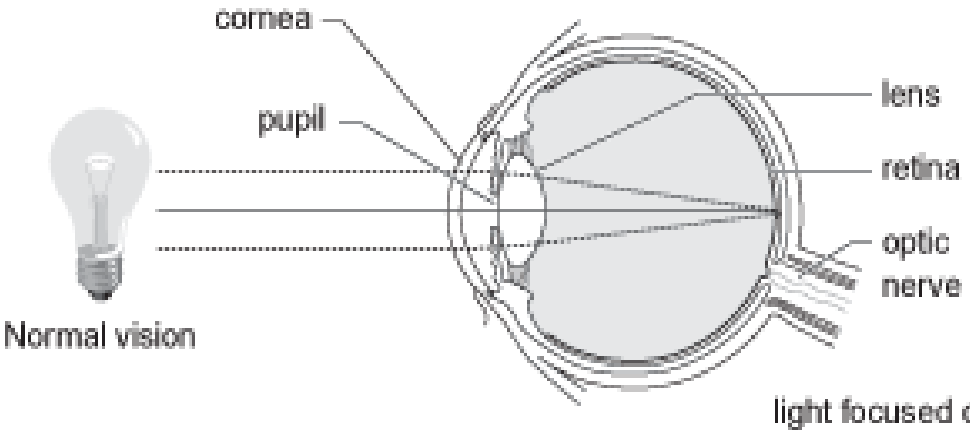
After barrage
Posterior Staphyloma

- B scan


STAPHYLOMA HAX 15:33 APR 02-98
S-2 60db 1550m/s 32.36mm

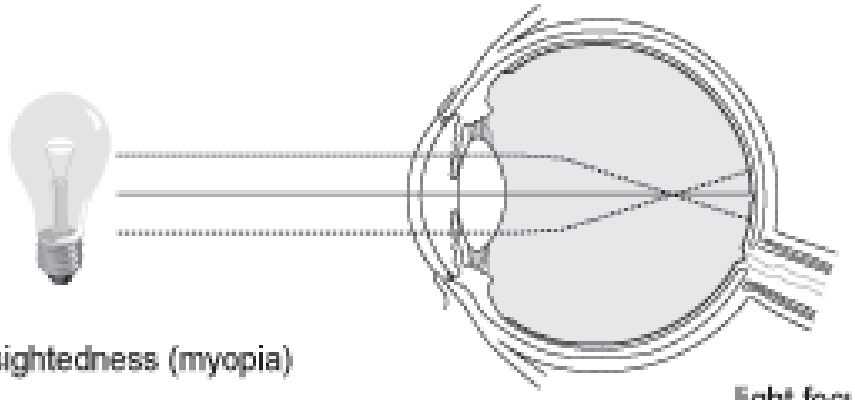

STAPHYLOMA 15:06 APR 02-98 MAN 80db
PHAKIC-1 1532/1641/1532
AXL = 32.15mm LENS = 4.87mm ACD = 2.77mm

Optics of Eye



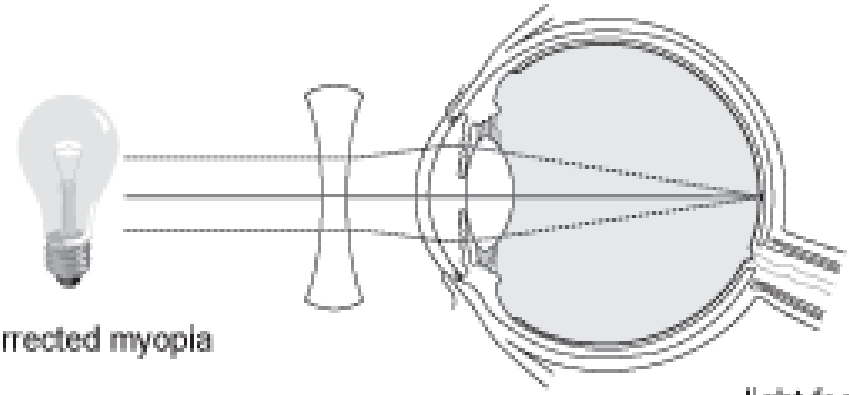
Normal vision

light focused on the retina



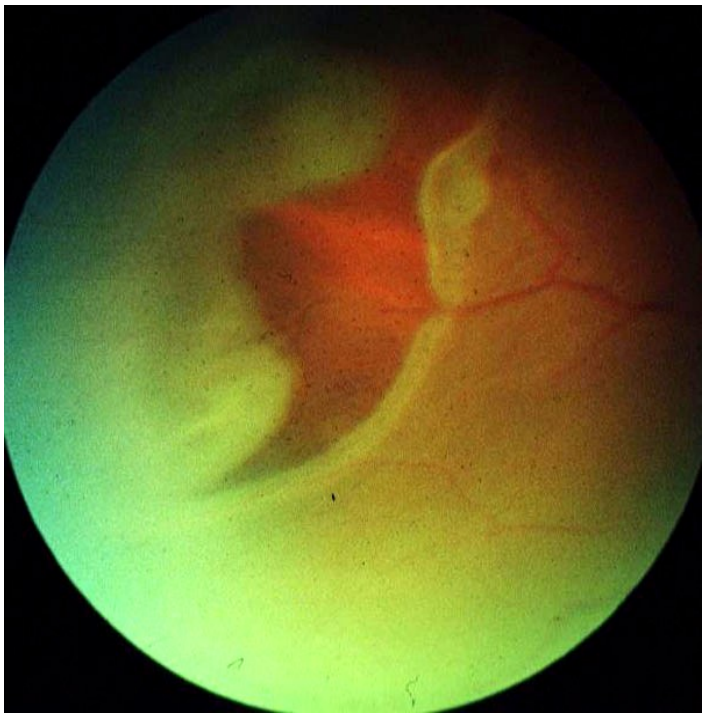
Shortsightedness (myopia)

light focused in front of the retina

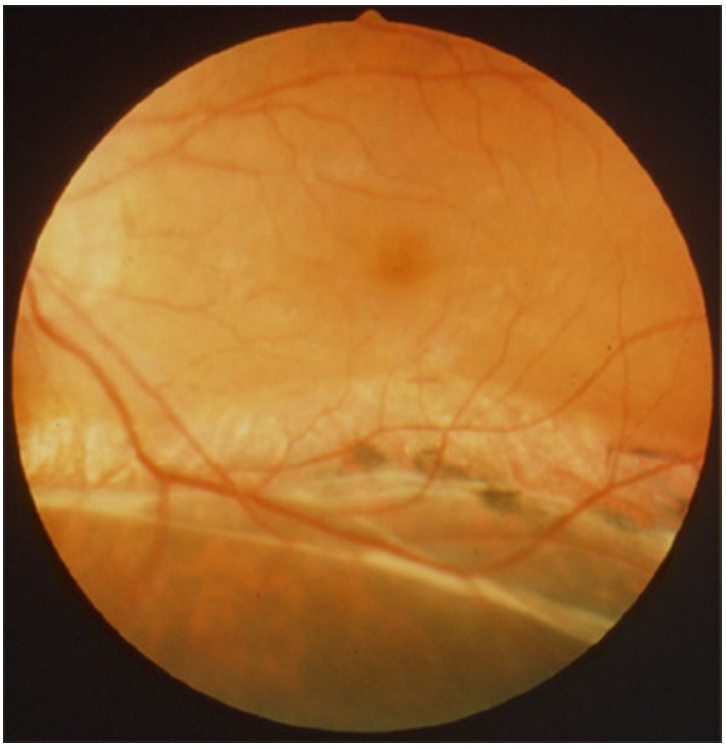


Corrected myopia

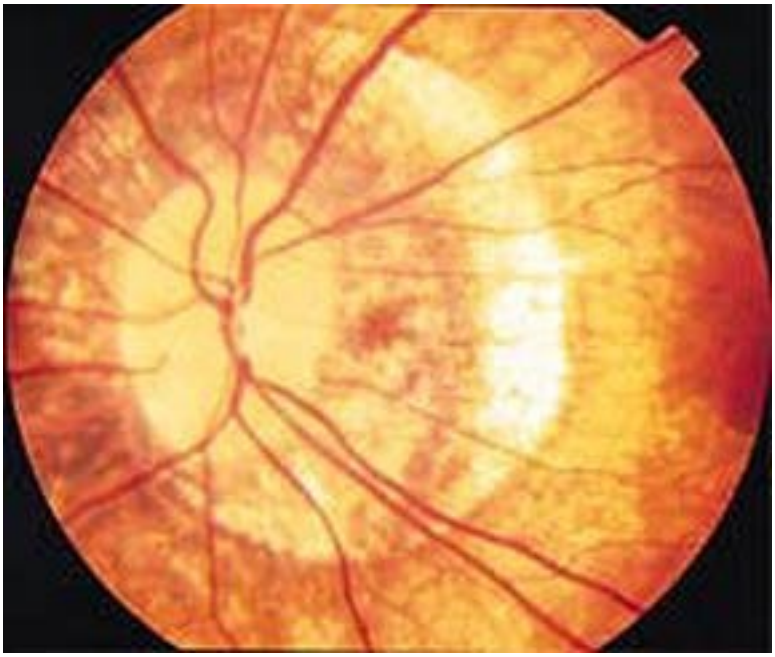
light focused on the retina
by a spectacle lens



Retinal Tear

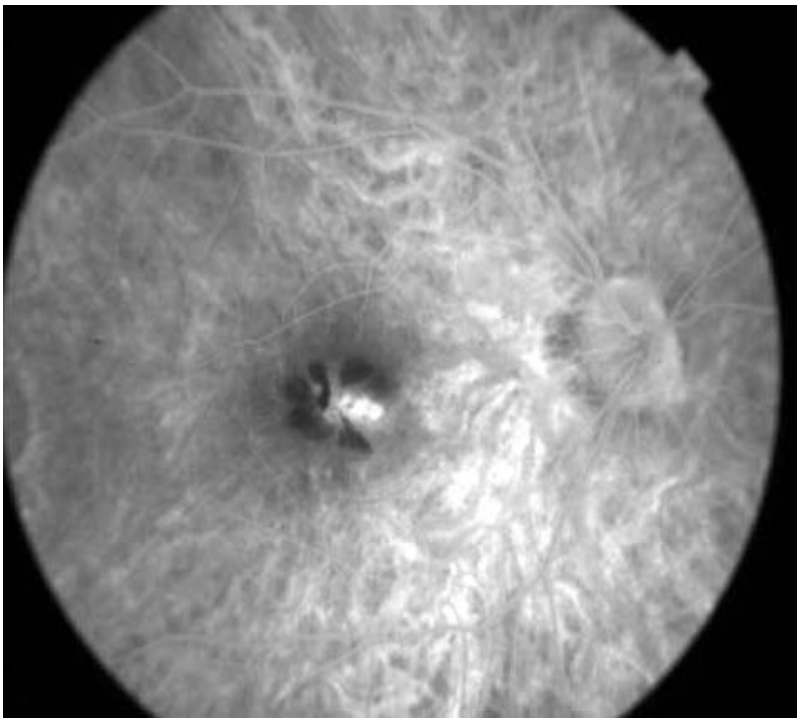


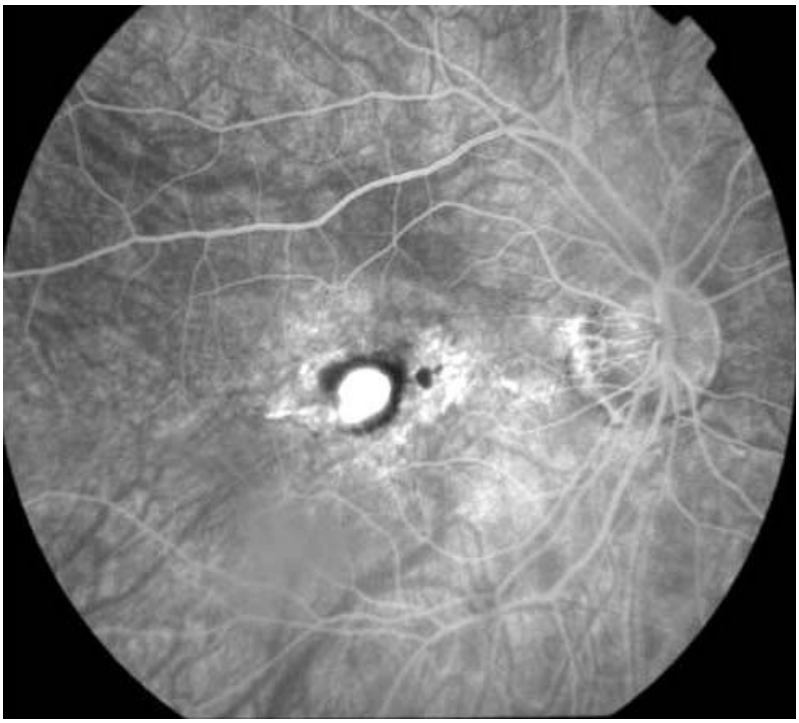
Retinoschisis



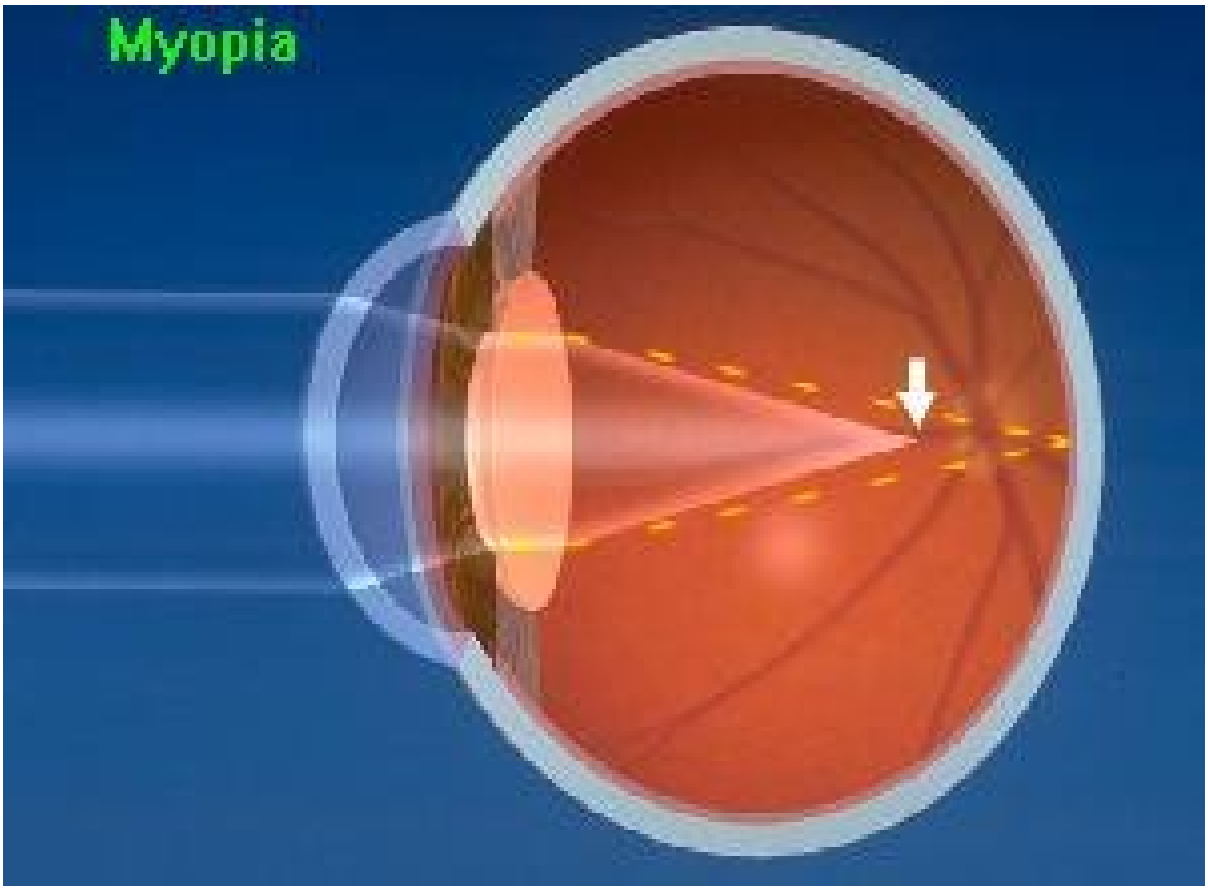
Posterior Staphyloma

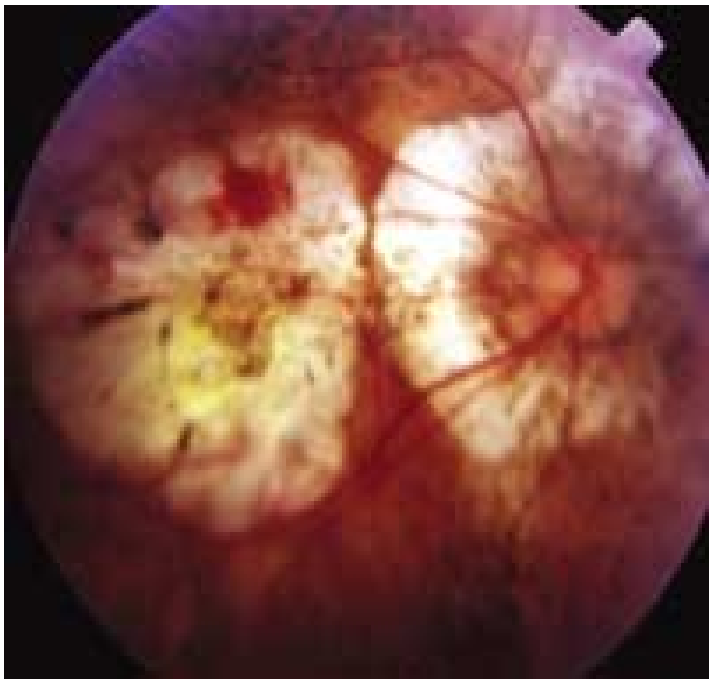
FFA - CNV



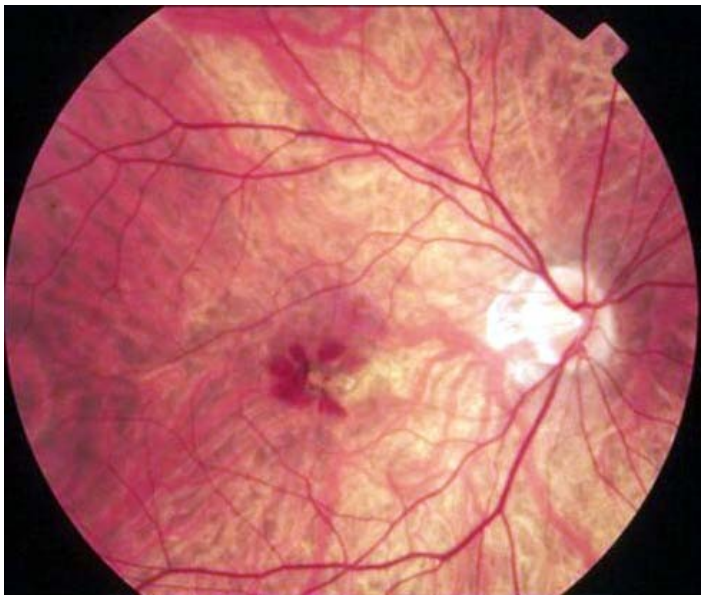


MYOPIA

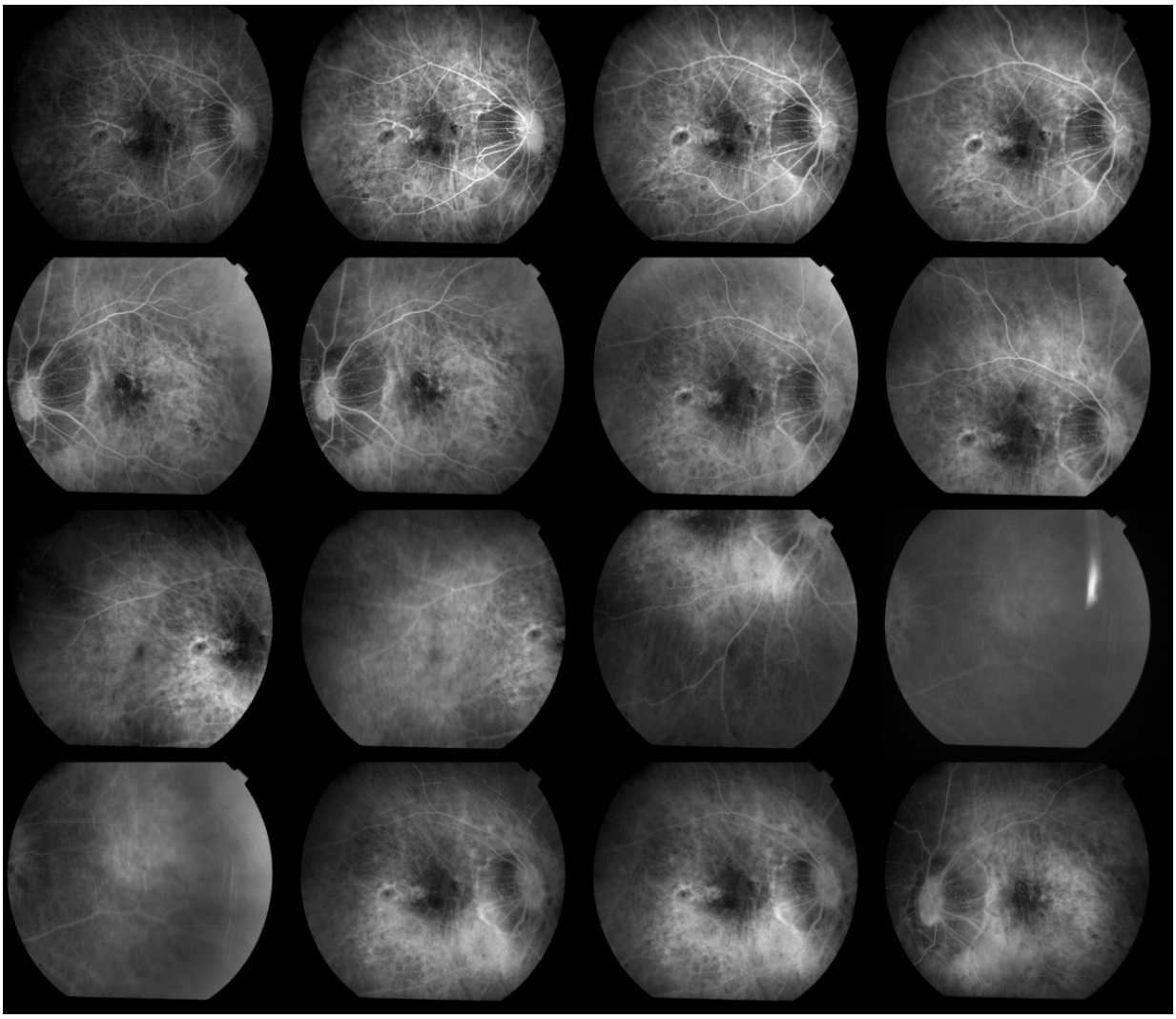

Myopia



Fuch’s Spot (CNV)

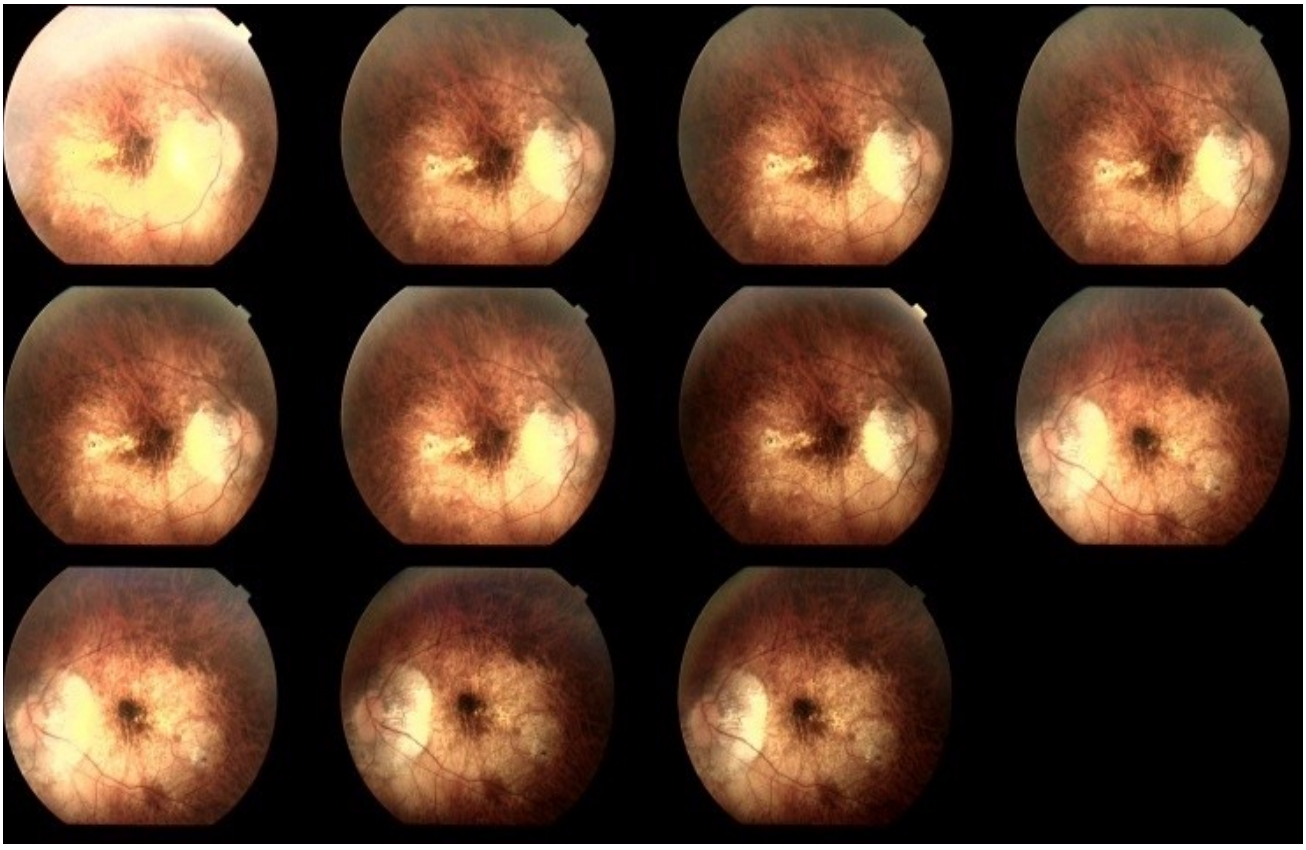


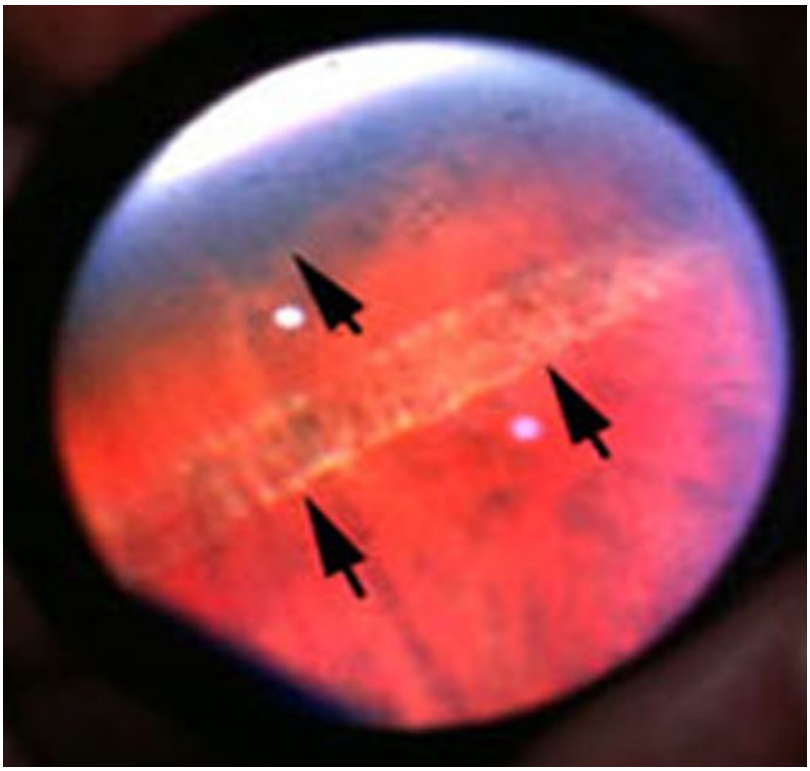
CNV
FFA of myopic fundus



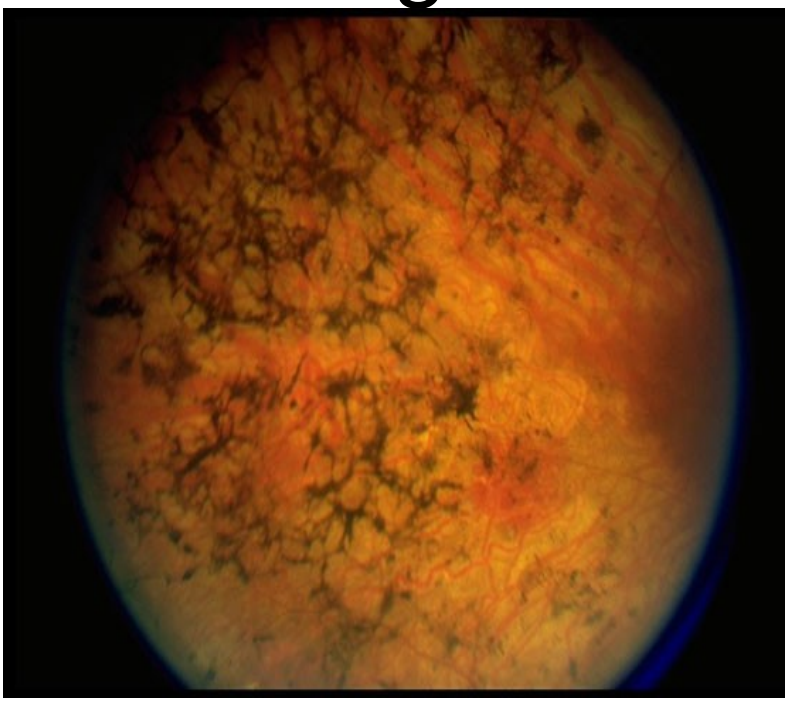
Fundus photographs in

myopia



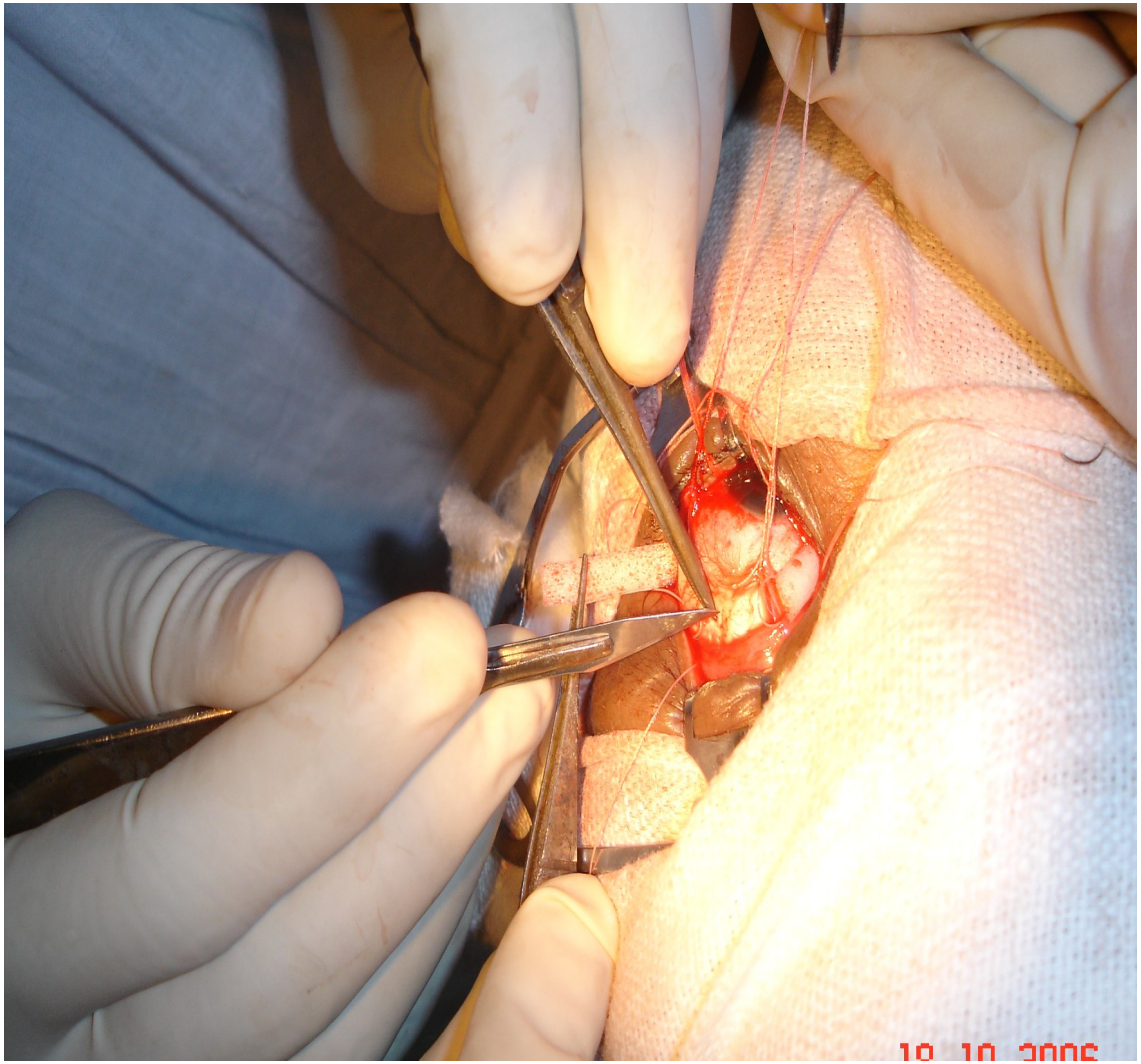


Lattice degeneration

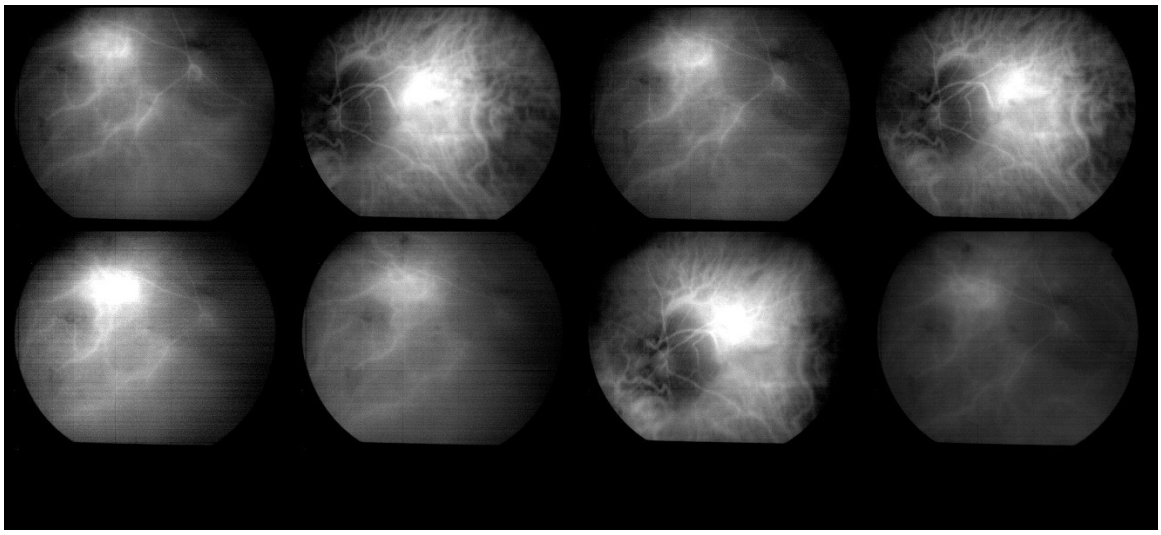


RP in Myopic fundus

RD surgery


18.10.2006

Keratometer



ICGA in Myopia