

CHAPTER II

CAUSES, PREVENTION AND CURE OF VISUAL IMPAIRMENT

[Expert comments: Dr. Vandana Nath, M. S. (Ophth.)]

1. Structure and Functions of the Eye

Each eyeball, about 2.5 cms. in diameter, is lodged within the socket called orbit. Between the orbital wall and the eyeball, there are several structures viz.

- *the voluntary muscles*
- *fat*
- *connective tissue*
- *lacrimal glands.*

All these structures are separated from the eyeball by a fascia called Buck's fascia. The voluntary muscles are concerned with the movement of the eyeballs. The lacrimal glands produce a fluid called tears.

The functions of tears are:

- *to maintain optical properties of the eye*
- *to wash away many irritants which may fall on the eyes*
- *to act as an disinfectant (as it contains lysozyme)*
- *to express emotions.*

Three coats of the eyeball are:

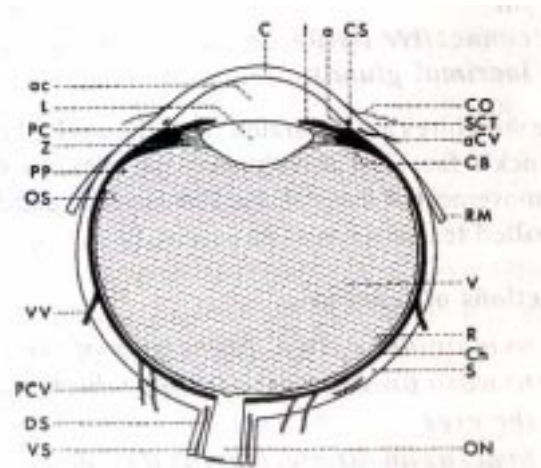
- *the outer coat, consisting of sclera and cornea*
- *the middle coat, called the uvea or vascular coat*
- *inner coat, called the retina.*

Sclera forms the outermost wall of the eyeball and is the white of the eyeball. It is composed of a dense, imperfectly elastic

supporting membrane. It helps to maintain the shape of the eye and supports the delicate structure within the eye

Conjunctiva is a thin clear mucous membrane which covers the front of the Sclera and is reflected from its surface on to the lids. It covers the interior surface of lids and joins them to the eye ball.

Cornea is the anterior part of the elastic supporting membrane of the globe which is transparent and clear. It is set into the sclera like a watch glass so that the latter overlaps the cornea all round the periphery. It is kept moist by a layer of tear film anteriorly and bathed on its posterior surface by aqueous humour. It permits light to pass through and helps focussing it on the retina along with the lens.



Source : Stephen J. H Miller (1990), Parsons' Diseases of the Eye, New York, Churchill Livingstone, P.4

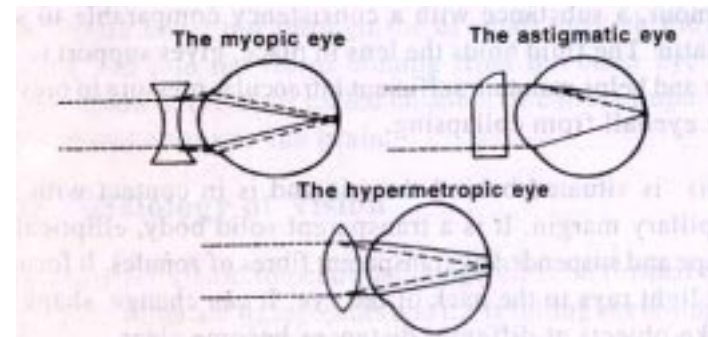
Fig. 2.1 : Diagram of a longitudinal section of the eyeball: a, angle of anterior chamber; ac, anterior chamber; aCV, anterior ciliary vessel; C, cornea; CB, ciliary body; Ch, choroid; CO, ocular conjunctiva; CS, canal of Schlemm; DS, dural sheath; I, iris; L, lens; ON, optic nerve; OS, ora serrata, PC, posterior chamber; PCV, posterior ciliary vessel; PP, pars plana; R, retina; RM, rectus muscle; S, sclera, SCT, sub-conjunctival tissue; V, vitreous; VS, vaginal sheath; VV, vortex vein; Z, zonule.

Uveal Tract: Lining the inner aspect of the sclera is a highly vascular middle layer of the eyeball, the uveal tract, concerned chiefly in the nutrition of the eye. It consists of three parts:

- *an anterior most part, the iris*
- *an intermediate part, the ciliary body,*
- *posterior most part, the choroid which accounts almost 2/3rd of the middle coat.*

Iris is the black disc beneath the cornea. The posterior surface of the iris is pigmented. The colour of the iris decides the colour of the eye. The muscles in the iris make the pupil larger or smaller.

Pupil is the black hole in the centre of the iris. The pupils look black due to the darkness of the interior of the eye. It controls the amount of light entering the eye. In bright light, the circular muscles of the iris contract and the pupils become smaller to reduce the amount of light that enters the eye. In the dark, the dilator muscles help the pupil to widen, allowing more light to enter the eye.



Source : Chapman and Stone's The Visually Handicapped Child in Your Classroom

Fig. 2.2 : Refractive Errors.

Cavity: The eyeball is not a solid sphere but contains a large interior cavity that is divided into two cavities, anterior and posterior. The anterior cavity has two subdivisions known as the anterior and posterior chambers.

Anterior Chamber is a space filled with fluid. It is bounded in front by the cornea, behind by the iris and part of the anterior surface of the lens which is exposed in the pupil. Its peripheral recess is known as the angle of anterior chamber which is concerned with the drainage of aqueous humour. The anterior chamber is 2.5 mm deep in the centre in the normal adults. It keeps the posterior surface of the cornea moist. It provides nutrition to the cornea and lens.

Posterior Chamber is the triangular space between the back of the iris and anterior surface of the lens and bounded on the outer side by ciliary body. It is filled with a jelly-like substance, the aqueous humour which is clear and watery and often leaks out when the eye is injured.

Posterior cavity of the eye ball is considerably larger than the anterior, since it occupies all the space posterior to the lens, suspensory ligament and ciliary body. It contains vitreous humour, a substance with a consistency comparable to soft gelatin. The fluid holds the lens in place, gives support to the eye and helps maintain sufficient intraocular pressure to prevent the eyeball from collapsing.

Lens is situated behind the iris and is in contact with the pupillary margin. It is a transparent solid body, elliptical in shape and suspended by transparent fibres of zonules. It focuses the light rays to the back of the eye. It can change shape to make objects at different distances become clear.

Retina is the innermost coat of the eyeball. It is a nervous layer within uveal tract. It mainly consists of nervous tissues and three layers of neurons viz.

- *photoreceptor neurons*
- *bipolar neurons, and*
- *ganglion neurons.*

The distal ends of the dendrites of the photoreceptor neurons are called rods and cones, descriptive of their shapes. These nerve endings are concerned in the reception and transformation of the light stimuli into electrical impulses.

Macula is the most sensitive part of the retina. The cones and rods differ as to numbers, distribution and function. The cones are most densely concentrated in a specially differentiated spot, fovea centralis, found near the centre of the retina, It is surrounded by a small area, the macula lutea or yellow spot. It is used for activities that need fine vision like reading and writing. It contains the greatest concentration of cones and is, therefore, the point of clearest vision in good light. The cones become less and less dense from the fovea outward. Rods, on the other hand, are absent entirely from the fovea and macula and increase in density toward the periphery of retina.

Optic Nerves: The fine fibres arising from each nerve cell in the retina come out through the eye ball through the optic nerve and join the fibres coming from the other eye at an intersection in the skull called chiasma. It carries impulses to the visual cortex in the brain.

2. Physiology of Vision

In order for vision to occur, an image must be formed on the retina to stimulate its receptors and the resulting nerve impulses must be conducted to the visual area of the cerebral cortex.

2.1 Formation of Retinal Image : Four processes are essential for forming a clear image on the retina:

- i. *Refraction of the light rays*
- ii. *Accommodation of the lens*
- iii. *Contraction of the pupil*
- iv. *Convergence of the eyes*

2.1.1 Refraction of the Light: It refers to deflection or bending of light rays. The refracting media of the eye are cornea, aqueous humour, lens and the vitreous humour. The light rays are reflected at the anterior surface of the cornea, at the anterior surface of the lens and the posterior surface of the lens.

Refraction in ophthalmology refers to measuring the refractive or light bending power of a person's eyes by various specially designed methods.

2.1.2 Accommodation of the Lens: If while looking at an object, situated at infinity, the gaze be transferred to an object near at hand, some readjustment of the power of the crystalline lens will have to occur, otherwise the image will fall behind the retina. This adjustment of the power of the lens is called accommodation. It requires three changes:

- i. Increase in the curvature of the lens*
- ii. Constriction of the pupils, and*
- iii. Convergence of the two eyes*

During accommodation, the ciliary muscles contract and this causes relaxation of the suspensory ligament and thus the anterior surface of the lens bulges and its power increases. Through this mechanism, the images focus nearer so that it is on the retina.

2.1.3 Constriction of the Pupil: As a part of accommodation mechanism, the circular fibres of the iris contract and that constricts the pupil. This prevents divergent rays from the object from entering the eye through the periphery of the cornea and lens. Such peripheral rays could not be refracted sufficiently to be brought to a focus on the retina and, therefore, would cause a blurred image. The pupil constricts also in bright light to protect the retina from too intense or too sudden stimulation.

2.1.4 Convergence of the Eyes: Convergence is the movement of two eyeballs inward so that their visual axes come together or converge at the object viewed. The nearer the object, the greater the degree of convergence necessary to maintain single vision.

2.2 Stimulation of Retina : The rods are known to contain rhodopsin (visual purple), a pigmented compound. It is highly light sensitive, so that when light rays strike a rod, its rhodopsin rapidly breaks down. This chemical change initiates impulse conduction by the rod. Then, if the rod is exposed to darkness for a short time, rhodopsin reforms from the opsin and is ready to function again. For this reason, when we want to see an object clearly in the daytime, we look directly at it so as to focus the image on the fovea. But in dim light or darkness, we see an object better if we look slightly to the side of it, thereby focusing the image nearer the periphery of the retina, where rods are more plentiful.

2.3 Conduction to Visual Area : The visual pathways consist of optic nerve, optic chiasma, lateral geniculate body of thalamus, optic radiation (optic tract), and the visual cortex of occipital lobe. Fibres from nasal portion of retina that conduct impulses from the rods and cones to visual cortex cross over to opposite side at optic chiasma, hence terminate in lateral geniculate body of opposite side. Thus each optic tract contains fibres from both the retinas. The result is that some information from each eye in the normal vision system arrives on each side of the brain.

3. Refractive Errors

The normal eye is called emmetropic. When a person with emmetropic eye gazes at infinity (20 feet or more), the rays incident to the eye are parallel and after refraction those rays are focussed on retina, i.e. image is formed on retina. While the abnormal condition is called errors of refraction or ametropia.

Ametropia: The condition in which incident parallel rays of light do not come to a focus upon the light-sensitive layer of the retina, may be due to one or more of the following conditions:

- *Abnormal length of the globe - axial ametropia*
- *Abnormal curvature of refracting surfaces of cornea or lens - curvative ametropia*
- *Abnormal refractive indices of the media - index ametropia.*
- *Abnormal position of the lens.*

The defects may also arise due to weakening of the eye muscles. The uncoordinated action of the muscles causes the failure of the visual axes of the two eyes to meet at the objective point. This results into squint.

Due to refractive errors, the lenses do not focus the rays correctly on the retina. The lenses focus light rays either behind or in front of it. The common refractive error are:

- *Myopia (Short-sightedness)*
- *Hypermetropia (Far-sightedness)*
- *Astigmatism*
- *Presbyopia*

3.1 Myopia (Short-sightedness): It is that dioptric or dioptic condition of the eye in which, with the accommodation at rest, the incident parallel rays of light come to a focus anterior to the light sensitive layer of the retina. Thus the image formed is not sharp and distant objects appear blurred to the person.

a. *Causes*

- *Anteroposterior diameter of the eye is longer than normal.*
- *Distance too great from the lens to the retina.*

b. *Symptoms*

- *Person is near-sighted i.e. the person can see near things clearly but has difficulty in seeing distant objects.*

c. *Signs*

- *Squinting or narrowing of the eye-lids*
- *Sitting very close to black-board, television or other visual objects*
- *Lack of interest in out-door activities*
- *Taking objects nearer to the eye.*
- *'Out of step' with the rest of the class*

e. *Risk*

- *Further visual deterioration from muscular haemorrhage or retinal detachment.*

d. *Diagnosis*

- *By a complete optometric examination*
- *Observant teachers and parents may discover it by observing the behaviour.*

e. *Correction*

- *Needs a concave or minus corrective lens in glasses or contact lenses to help the eye to focus light rays on the retina.*
- *Visual training depends upon degree, type and vision problems associated with this condition.*

f. *Prevention*

- *No certain prevention*
- *Best recommendation is observance of the rules of good health and regular optometric examination.*

3.2 Hypermetropia(Far-sightedness) : Hypermetropia is that dioptric or dioptic condition of the eye which, with the accommodation at rest, incident parallel rays come to a focus posterior to the light sensitive layer of the retina. Thus distant objects are seen clearly while near objects are not seen clearly.

a. *Causes:*

- *Antero-posterior diameter of the eye is shorter than normal.*
- *Distance too short from the lens to the retina.*

b. *Symptoms*

In the young children, the condition may cause no symptoms. When the following symptoms arise, the condition is often called accommodative asthenopia or eye-strain.

- *General fatigue after prolonged use of the eye*
- *Difficulty in concentrating & maintaining clear vision in reading.*
- *Burning eyes, headache*
- *Irritability or nervousness after sustained visual concentration and even nausea.*

c. *Signs*

- *In young children, hypermetropia, is a predisposing cause for convergent squint.*
- *Reading material is held at a further distance than usual in order to be seen clearly.*

c. *Detection*

- *By a complete optometric examination*
- *Observant teacher and parents are very important in early detection.*

d. *Correction*

- *Prescribing convex or plus corrective lenses in glasses or contact lenses to help to focus light rays on the retina.*
- *Visual training depending upon degree, type and vision problems associated with this condition.*

3.3 Astigmatism : In this condition, the eye has a misshapen curve referred as curvature ametropia. It produces a distorted image on the retina which causes another very troublesome

refractive error called astigmatism. In most of these cases, the cornea is at fault and the error is generally of such a nature that its surface is flatter from side to side than it is from above downwards. Thus the image formed on the retina is blurred.

a. *Symptoms*

- *Eyestrain*
- *Aching of the eyes, headache*
- *Eyes quickly become fatigued with reading*
- *Letters are described as running together*
- *Copying incorrectly.*
- *Failure to see all the lines of a diagram simultaneously*

b. *Treatment*

- *Full optical correction for constant use for both distant and near vision*
- *Glasses with cylindrical lenses*

3.4 Aphakia : This is the condition of the eye when the crystalline lens has been removed. The eye is extremely hypermetropic and all accommodation is lost.

a. *Correction*

- *Strong correcting lenses or contact lenses or intraocular lenses.*

3.5 Presbyopia : The crystalline lens at the age of 40 years and above becomes rigid, so that, during accommodation, even though the ciliary muscles are contracting, it is unable to change its shape to focus near objects. Light is formed behind the retina and the near point of the eye recedes.

a. *Symptoms*

- *Difficulty in reading, sewing or near work*
- *Cannot see printed words or small objects when held at 'usual' distance for reading*

b. *Correction*

- *Appropriate ‘reading glasses’, that is, convex lenses for doing near work.*

3.6 Refractive Errors of Normal Eyes : The errors of refraction described above are all examples of pathological conditions. Even in normal persons, following errors may be seen:

- *Spherical aberration, and*
- *Chromatic aberration*

3.6.1 Spherical Aberration: Even in a normal person, the power of lens at the extreme of periphery, is not identical with the power in its central part. Therefore, when the pupil is widely dilated - in darkness or after administration of atropine - some blurring of vision may occur and is called spherical aberration.

3.6.2 Chromatic Aberration: The rays of the different wave length are refracted differently at the periphery of the lens of the eyes, causing what is known as chromatic aberration. As red light is refracted least whereas the violet light the most and consequently on looking at a source of white light, the red light falls posterior to and the blue light anterior to the retina.

4. Major Causes of Visual Impairment

Many conditions can contribute to the impairments of the eye structures and tissue. Whether such impairment leads to limitations in visual functioning, however, depends upon such factors as:

- *Site, type, etiology and severity of tissue damage*
- *Age of individual at the time the problem occurred*
- *Nature and quality of treatment*
- *Extent of follow-up*

Site refers to location within the orbit or globe; type indicates the diagnosis; and etiology refers to the cause of eye affection. The figures in Table 2.1 point out the causes of blindness, based on definition of 6/60 (20/200 Snellen) or less in better eye after all correction.

4.1 NPCB - WHO Survey : Two major surveys have been conducted in India and they provide data on causes and prevalence of visual impairment in India: one by India Council of Medical Research in 1971 and second by WHO -NPCB in 1986. The first observation of these surveys is that the prevalence of blindness in India has increased from 1.38 percent in 1971 to 1.49 percent in 1986. Secondly, blindness due to cataract has increased from 55 percent in 1971 to 81 percent in 1986.

Table 2.1

Causes of Visual Impairment in India (NPCB - WHO survey)

S.N.	Causes of Blindness	ICMR Study (%)	WHO-NPCB Survey (%)
1.	Cataract	55.00	81.00
2.	Refractive Errors	-	7.00
3.	Corneal Opacity	-	3.00
4.	Glaucoma	0.50	2.00
5.	Trachoma	5.00	0.20
6.	Malnutrition	2.00	0.04
7.	Other Infections	15.00	-
8.	Small Pox (Old Cases)	3.00	-
9.	Injuries	1.50	-
10.	Others	18.30	6.76
TOTAL		100.00	100.00

Source: NPCB Publications

The WHO - NPCB Survey 1981-86 also made the following projections.

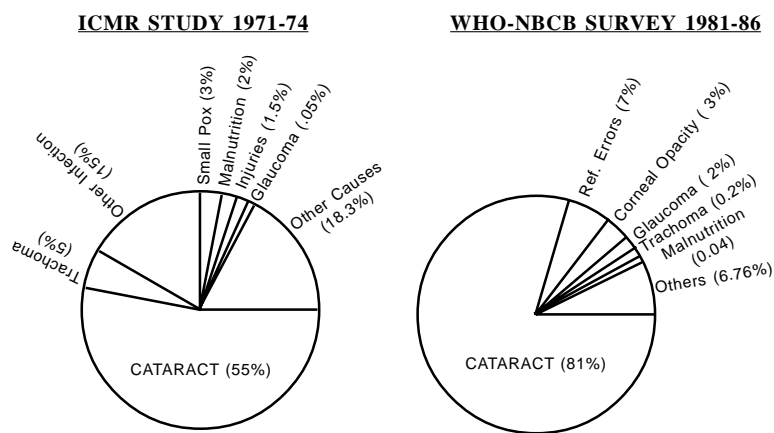


Fig. 2.3 : Causes of Visual Handicap

4.2 NSSO Survey : The NSSO Survey (1992) establishes that the old-age and cataract are the major causes of visual impairment.

Table 2.2

Major causes of visual impairment (NSSO survey)
(Distribution per 1,000)

S.N.	Cause of Visual Impairment	Distribution per 1,000	
		(Rural)	(Urban)
1.	Old age	273	214
2.	Cataract	236	280
3.	Other eye diseases	130	107
4.	Injuring other than burns	32	35
5.	Glaucoma	34	42
6.	Smallpox	29	35
7.	Severe diarrhoea	11	13
8.	Not known	161	130
9.	Others	94	144
Total		1000	1000

The National Sample Survey reveals that old-age is the major cause of visual impairment in the rural areas which accounts for 27 percent visual impairment. Whereas cataract is its major cause the urban areas with 27 percent visual impairment. Almost 50 percent of visual impairment both in rural as well as urban areas is caused due to old-age and cataract. The survey could not establish any definite cause in case almost 25 percent and 27 percent for the rural and urban areas respectively.

The WHO- NPCB Survey establishes that cataract causes 81 percent of visual impairment in the country. Majority of cases which reported that the cause of visual impairment as old-age at the time of National Survey might have lost vision due to cataract. While both the National Sample Survey as well as WHO - NPCB establish cataract as one of the major causes, the findings of these surveys have shown lot of disparities as regard other causes of visual impairment.

4.3 NationalLoad : The National load for leading causes of blindness in India at the population level of 800 million is as given below:

Table 2.3

National Load	
Cause of Blindness	National Load in Million
Cataract	25.76
Refractive Errors	2.24
Corneal Opacity	1.09
Glaucoma	0.63
Trachoma	0.08
Vitamin A Deficiency	0.01
Others	2.03
Total	31.84

Source : WHO - NPCB survey

4.4 Prevalence Rate of Blindness

Table 2.4

Prevalence Rate of Blindness

Eyes	Prevalence Rate	Estimated Numbers (at 800 million Pop.)
Both Eyes	1.49%	11.92 million
One Eye	0.92%	7.84 do
Eyes	1.99%	31.84 do

Source : WHO - NPCB Survey

4.5 Rural - Urban Distribution

Total of Economic Blindness	: 1.49%
Rural	: 1.62%
Urban	: 1.03%

Incidence of blindness is higher in rural areas as compared to urban areas.

4.6 Curable and Incurable Blindness

Table 2.5

Extent of Curable Blindness

	Surgi- cally Curable	Non-sur- gically Curable	Incu- rable	Uncertain Prognosis
National Projections	77.43%	10.63%	5.99%	5.99%
National Load in Million	17.0	2.35	1.32	1.32

Source : WHO - NPCB Survey

The backlog of curable blindness in the country at the population level of 800 million is 19.35 million i.e. these surgeries are pending and hence have resulted in the suffering persons becoming blind. The current estimated rate of cataract surgery per annum in the country is 1.2 million (1990 level, reported to be 2.7 million during 1998) only. Whereas incidence of cataract alone is between 2.97 million to 4.67 million. Thus only 40 per cent of the persons who suffer in any single year are covered. The remaining 60 per cent are added to the cataract backlog which stands at 19.35 million.

With increasing longevity, the incidence of eye diseases and disorders is on the rise, whereas increase in facilities for eye care and eye surgery have not kept pace with the increasing incidence. This has resulted into an increasing backlog of eye surgery, incidence of blindness as well as prevalence of blindness.

5. Classification of Causes of Visual Impairment

The simplest classification of causes of visual impairment is:

- *Ocular Diseases and Anomalies*
- *General and Systemic Diseases*
- *Injuries and Accidents*

5.1 Ocular Diseases and Anomalies:

a. *Buphthalmos*: It is infantile glaucoma, one of the rarest conditions in children. As infant's eye is elastic, increased eye-ball pressure causes the eye to enlarge. It occurs mostly due to failure of development of tissues in region of anterior chamber. It results into excessive watering, photophobia & cornea becomes cloudy. Due to altered shape of eye, refractive errors may occur.

b. Albinism: This is a hereditary condition involving defective development of pigment in hair, skin & eye. In 'ocular albinism', only eyes are affected. The amount of pigmentation may increase slightly with age up to adolescence and that results into improvement into visual acuity.

i. Signs

- *Associated with photophobia, decreased visual acuity, nystagmus and refractive errors.*
- *Difficult going outside on a bright day*
- *Any glare would cause difficulty*

ii. Precautions

- *Such children not to be seated near windows*
- *Level of lighting may be adapted*
- *Need glasses to help their distant vision*
- *Genetic counselling to the teen-agers*

c. Retinitis Pigmentosa: A hereditary slow degenerative disease of the retina. The condition affects the peripheral area of retina including rod cells. It may result into night blindness, tunnel vision and inability to see in dark. Though some children are born with poor vision, it begins in childhood. It is progressive and results into blindness in middle or advanced age. Visual acuity is often normal, the field of vision is so poor that the person falls in the category of blindness. It is also associated with other diseases including hearing loss.

Precautions

- *A close watch by parents and teachers to note any changes in the vision.*
- *Sympathetic and proper handling and understanding of socio-psychological and behaviour problems of the individual.*
- *Training in visual skills of scanning and reorientation.*
- *Training in orientation & mobility*
- *Genetic counselling of the individual.*

d. Retinoblastoma: This is malignant tumour of the retina. It is generally confined to infants, probably always congenital and some cases are heredity. It is often a bilateral condition and both the eye balls may have to be removed.

Treatment

- *Treated by radiation or photo-coagulation*
- *Generally surgery is necessary to remove the affected eye.*
- *Genetic counselling is desirable.*

e. Retrolental Fibroplasia: It is associated with pre-mature birth children who have been given high concentration of oxygen. It is caused due to formation of new vessels and proliferation of fibrous tissue in the retina. As it results into formation of a membrane in the back of the lens of the eye, vision is fragmented. It is usually a bilateral condition. There is a risk of further visual deterioration from retinal detachment or glaucoma.

f. Retinal Detachment: It refers to separation of the retina proper from its pigment epithelium layer. From the clinical point of view, it is divided into 2 classes:

- i. *Secondary detachment - due to an obvious mechanical cause, subsequent to other happenings in the eye*
- ii. *Simple detachment - due to development of a hole in the retina.*

It is caused by degenerative myopia, diabetes, diabetic retinopathy. It leads to painless loss of vision, appearance of flashing lights, visual field loss and decreased visual acuity. It is generally treated by laser surgery and cryosurgery.

g. Diabetes Mellitus: It is a hereditary disorder and affects retina. Also known as diabetic retinopathy and it is common

after the diabetes has lasted for 10 years. Due to this, senile cataract develops at an earlier age and more rapidly than usual. It leads to fluctuating vision, loss of colour vision, or visual field, refractive error, decreased visual acuity. It is treated medically, along with dietary control, spectacle correction and laser therapy for retinopathy.

h. Trachoma: It is a chronic contagious disease of the conjunctiva and cornea caused by an organism chlamydia. The primary infection affects conjunctiva and follicles and corneal involvement causes ulcers. As lid deformities cause misdirected eyelashes, further complications take place. It can be treated with medication & surgical correction of deformed lids.

i. Glaucoma: It is caused by an obstruction in aqueous outflow channels at angle of anterior chamber. It also results in the rise in intraocular pressure which is detrimental to the eye. It is usually a hereditary, symptomatic condition.

j. Cataract: In Latin, word ‘cataract’ means waterfall that explains appearance of the eye when lens becomes cloudy and opaque. It refers to loss of transparency of the lens due to altered physio-chemical processes within tissues. It is usually associated with advanced age. If present at birth, it is referred as congenital cataract. It may be associated with:

- *Ocular disease, e.g. complicated cataract*
- *Systemic disease, e.g. diabetes mellitus*
- *Radiant energy, e.g. infra-red or radiation cataract*
- *Injury.*

5.2 General and Systemic Diseases : Many general and systemic diseases that effect the vascular and metabolic systems put the eyes at risk. Major diseases which may result into visual impairment are:

a. Hypertension: Vascular retinopathy is associated with raised blood pressure along with pronounced degenerative changes in the retinal vessels. The circulatory changes lead to development of retinal edema.

b. Vitamin A Deficiency: Vitamin A is essential for the build up of the surface tissues in our body, including eye. Vitamin A deficiency may lead to corneal damage, ulceration and blindness, particularly in combination with measles or malnutrition.

It is also known as:

- *Xerophthalmia*
- *Blinding malnutrition*
- *Disease of darkness.*

Causes

- *Insufficient and unbalanced food intake by the mothers and the children*
- *Low absorption due to diarrhoea or malnutrition*
- *Increased demand of Vitamin A during and after measles infection*
- *Vitamin A deficiencies owing to interference with the reformation of the visual purple leads to:*
 - * *Xerosis of the conjunctiva*
 - * *Keratomalacia and*
 - * *Night blindness*

d. Chronic Diarrhoea: It is a cause of blindness in rural areas. Generally loss of vitamin A leads to softening of cornea which results into Keratomalacia.

e. Multiple sclerosis, thyroid gland disorders, certain vitamin deficiencies, and other systemic diseases can lead to eye problems with vision loss.

5.3 Injuries and Accidents : Injuries, accidents and poisonings account for many known instances of visual impairment among school age groups. Actually, injuries and accidents are not considered a major cause of blindness since technically both eyes would have to be severally affected. The injuries are a major cause of preventable, curable and monocular visual impairment. Most common injuries and accidents are:

- *Traumatic and chemical injuries*
- *Lodging of foreign body in the eye*
- *Chemical burns*

6. Early Intervention

In case of visual impairment, early eye examination is of utmost importance. All eye surgeons have been exposed to the frustration of an adult when told that nothing can be done to improve vision in the lazy (amblyopic) eye. This can be prevented to a great extent in majority of cases if it can be detected around the age of 3-4 years.

It has been observed that 24 percent persons have refractive errors and many of these errors are present at birth and go un-noticed for a long time until the person is quite old. It happens more often when errors are more in one eye than the other.

Signs to watch for early detection: (As adopted by UNICEF)

General symptoms that may occur from birth:

- *The child squints or blinks when looking at something.*
- *The child's eyes are crossed.*
- *The child favours one eye more than the other when looking at an object.*
- *One or both of the child's eyes turn in or out.*
- *The child's pupils are hazy.*
- *The child's eyes are tearing excessively, are red, or the eye-lids are encrusted with matter.*
- *The child turns or tilts his head abnormally.*
- *The child has frequent or persistent sties.*

0-3 Months:

- *Infant does not follow an object in his visual field.*
- *Infant does not play with his hands.*

3-6 Months:

- *Baby does not reach for toys in his visual field.*
- *Baby does not make eye contact when being fed or cuddled.*
- *Baby does not visually inspect objects in his hand.*

6-9 Months:

- *The motor skills of a baby do not develop such as rolling over, sitting or crawling.*
- *Baby does not appear to discriminate between similar objects or people.*
- *Baby does not pick up small objects successfully.*

9-12 Months:

- *Baby shuts or covers one eye when focussing.*
- *Baby holds playthings very close to eyes.*
- *Baby bumps into large objects when crawling.*
- *Baby rubs his eyes excessively.*
- *Baby does not attempt to grasp spoon or cup when being fed.*
- *Baby does not appear to notice interesting or bright coloured objects that are at a short distance.*
- *Baby does not imitate simple motor play such as waving bye bye.*

1-2 Years:

- *Child's walking is delayed.*
- *Child bumps into large objects.*
- *Child is not interested in playing.*
- *Child is not interested in picture books.*
- *Child holds books or objects very close or far from the eyes to see them.*
- *Child appears to be afraid to walk or move in strange environment.*
- *Child is clumsy and awkward for his age.*

2-5 Years:

- *Child stumbles over small objects.*
- *Child bumps into large objects, is clumsy and awkward.*
- *Child is not interested in games involving catching, throwing, bouncing or tagging.*
- *Child is not interested in tasks that require sustained visual concentration.*
- *Child is not interested in books.*
- *Child complains of: headaches, nausea, dizziness, burning or itching of eyes, blurring of vision.*
- *Child can not see distant things clearly.*
- *Child places head close to the tasks he is doing.*
- *Child does not notice colour differences.*

School Age:

Teacher or parent may observe:

- *Child's body is rigid while looking at distant or near objects.*
- *Child has short attention span and daydreams.*

- *Child places head close to book or desk when colouring, reading or writing.*
- *Child uses unusual or fistful pencil grasp, frequently breaking pencil.*
- *Child has a spidery, excessively sloppy, or very hard to read handwriting.*
- *Child closes or covers one eye.*
- *Child dislikes tasks requiring sustained visual concentration; is nervous, irritable, restless or unusually fatigued after maintaining visual concentration.*
- *Child loses place while reading and uses the finger or marker to guide the eyes.*
- *Child has difficulty in remembering what is read.*
- *Child skips words and re-reads.*
- *Child has difficulty remembering, identifying, and reproducing basic geometric forms.*
- *Child has difficulty in sequential concepts.*
- *Child has poor eye-hand co-ordination and unusual awkwardness including difficulty with stairs, throwing and catching ball, buttoning and unbuttoning and tying.*
- *Child is easily frustrated, is withdrawn and has difficulty getting along with children.*

7. Prevention and Cure of Visual Impairment

As xerophthalmia, cataract, trachoma, glaucoma and diabetic retinopathy are the most common causes of visual impairment, important steps to be taken to help prevent the same are mentioned below:

7.1 Prevention and Cure of Xerophthalmia :

a. Complaint

- *The patient is usually a pre- school child, who may be sick, specially with diarrhoea or measles*
- *Poor vision*
- *Night blindness*
- *Difficulty seeing in dim light*
- *Eyes become sensitive to bright light*



Source :Ophthalmology Section, Directorate General of Health Services (1996), National Programme for Control of Blindness, P. 14.

Fig. 2.4 : Vitamin A Defficiency (Xerophthalmia)

b. Signs

- *A line or spot on the conjunctiva*
- *Thick white spots on both sides of the cornea*
- *Conjunctiva becomes wrinkled*
- *Cornea erupts*
- *Scar forms over cornea*
- *Scar is opaque and impairs vision while the eyeball shrinks causing complete blindness*

c. Examination and findings

- *Cornea appears dry, rough and cloudy*
- *The child may be poorly nourished and sick*
- *See if the child can fix and follow an object such as your hand*

d. Action to be taken

- *Immediately- give oral 200,000 IU vitamin A*
- *Apply antibiotic ointment (twice daily)*
- *Apply a protective eye shield*
- *Refer for further medical treatment the same day*
- *If referral not possible: next day give a further dose of oral vitamin A, 200,000 IU, and again two weeks later (same dose)*

e. Important points to prevent Xerophthalmia

- *Breast-feed vitamin A rich colostrum (the first breastmilk) to the new born baby*
- *Breast-feed infants for at least one year*
- *Start at 3-6 months to feed infants locally available leafy green vegetables rich in vitamin A, well-cooked finely chopped, and mixed with other food, if possible, to make them more acceptable*
- *Include dark green leafy vegetables or fruits in the feeding of pre-school children every day*
- *Include yellow-orange fruits rich in Vitamin A (i.e. papaya and mango) in the child's diet*
- *Include fat in the child's diet, with dark green leafy vegetables, fruit and other sources of vegetables*
- *Pregnant and lactating women should eat food rich in vitamin A every day*
- *Administer vitamin A 200,000 IU in oil by mouth to mothers after the birth of the child or within one month after birth*
- *Educate families that night blindness is an early warning sign of xerophthalmia and can be treated by feeding vitamin A in oil by mouth*
- *Teach school children to detect and report night blindness in younger children*

- *Learn how to recognize, treat and prevent xerophthalmia.*

7.2 Prevention and Cure of Cataract : Cataract is termed as cloudy lens inside the eye.

a. Complaint

- *Gradual loss of vision over a long period of time*
- *Lens often changes from being clear to a milky white colour*
- *Feels as if looking through a dirty window*



Source :Ophthalmology Section, Directorate General of Health Services (1996), National Programme for Control of Blindness, P. 14.

Fig. 2.5 : Cataract eye

b. Examination and findings

- *Gray or white pupils*
- *Usually both eyes are affected*
- *Usually found in old people*
- *Measure the vision*

c. Action to be taken : Refer for further examination and possible operation if:

- *patient can not perform daily activities*
- *mobility of the patient is restricted*
- *vision is worse than 6/60 or finger counting at 6 meters in both eyes*

7.2.1 Important Points for Prevention of Cataract: Although there is no medicine to prevent cataracts, an operation can be performed to help restore vision. The following precautions may help prevention of cataract:

- *Take a good and nourishing diet rich in protein and vitamin, such as milk, papaya, mango, carrot, spinach, egg and fish*
- *Protect the eyes from excessive exposure to sun rays, intensive heat, X-rays and injuries*
- *Treat diseases like diabetes and syphilis effectively*
- *Can not be cured by application of any medicine to the eye or by taking any medicine orally*
- *In the beginning eye-sight can be improved with glasses*
- *Obtain suitable glasses after getting the eyes tested*
- *Power of glasses changes with the progress of cataract*
- *After maturity of cataract, surgery is needed to restore vision*

7.2.2 Organizing Eye Camps: The Camp approach has become very popular for the prevention of visual impairment and cure of cataract, glaucoma etc. Following steps may be taken for organizing the eye camps:

- *Collaborate with an eye hospital or blindness prevention organization*
- *Identify the persons having eye troubles and who need immediate eye check-up*
- *Avail financial assistance from any one of the following agencies:*

- a. National Programme for Prevention and Control of Blindness
*Directorate General Of Health Services
Nirman Bhawan, New Delhi 110 011*
- b. Sight Savers International
*A 3, Shivdham, New Link Road
Malad (W), Mumbai 400 064*
- c. Christoffel Blindenmission
*South Asia Regional Office (North)
YMCA Cultural Central Building
1, Jaisingh Road
New Delhi - 110 001*
- d. Christoffel Blindenmission
*South Asia Regional Office (South)
559, 11th Main Road
Hall II Stage, Indiranagar
Bangalore - 560 008*
- e. DANIDA
*A-148, Safdarjung Enclave
New Delhi - 110 029*
- f. OXFAM (INDIA)
*C6/59, Safdarjung Development Area
New Delhi - 110 016*
- g. Helpage India
*TRDC, C-14, Qutab Institutional Area
India Habitat Centre
Zone -V, II Floor, Lodhi Road
New Delhi - 110 016*
- h. Shri Manav Kalyan Trust
*II floor, Swapna Complex
Jawaharnagar Chowk
Maninagar, Ahmedabad 380 008*

- i. Local Lions, Lioness and Leo Clubs
- j. Local Rotary, Rotaract and Inner Wheel Clubs
- k. Local Eye Hospitals
- l. State Department of Public Health
- m. District Blindness Control Societies
 - Create public awareness using pamphlets in the local language and other suitable means e.g. beating of drums, puppet shows etc.
 - Organize eye check up camps with the involvement of the local eye hospital or the local Ophthalmic Surgeons
 - Provide treatment, medicines, eye drops to the patients not requiring eye surgeries
 - Organize eye camp in the central village with the involvement of the village Panchayat, youth club or any other local organization
 - Arrange the follow up of the cases who have been operated in the camp
 - Arrange for the eye check up of all these cases and provide suitable glasses or eye drops etc.

7.2.3 Hospital Based Surgery

7.2.3.1 Limitations of Camp Approach: While the camp approach enables en-masse eye surgeries in the remote areas, it has the following limitations:

- Does not assist in the planned development of permanent intervention strategies.
- Due to temporary structures and poor quality of infrastructure, its difficult to maintain acceptable standards of quality of services.

- Due to large expenditure on creating make-shift facilities, the unit cost of surgeries may be exorbitant, particularly when the number of surgeries performed in one camp are lesser.
- Not within the distance a service provide can reach regularly as and when required
- Not available at the time when the patient requires it the most and can manage it.
- Non-existent, irregular or many-a-times no follow up services.

7.2.3.2 Alternatives to Camp Approach: Due to these limitations, a tremendous shift from the provision of cataract surgeries performed in one-time eye camp to establishment of permanent eye care facilities which operate throughout the year is essential. The following alternatives in this respect are available:

- a. Supporting, as an interim measure, eye care activity outside the eye hospitals by establishing eye units in the General Hospitals.
- b. Promoting outreach screening or diagnostic camps where patients identified for eye surgeries are transported to a hospital for eye surgeries, treatment and post operative care.
- c. Establishing satellite hospitals in the rural areas which perform refraction, eye screening, eye check-up, treatment, simple surgeries, follow up and public awareness etc. All those persons who require further diagnostic or surgery etc. are referred to base eye hospital. The satellite hospital coordinates transporting these patients, post-operative follow up, refraction and other support services for these patients.

- d. Promoting establishment of Rural Eye Hospital with optimum capacity of 20 beds or less for performing refraction, eye screening, diagnostic, treatment and eye surgeries etc. These hospitals may refer complicated cases to a cluster level or district level speciality eye hospitals.

Eye care needs to be tackled as strategy which focuses on development of appropriate physical facilities and equipment, development and upgradation of human resources and higher quality of planning.

7.2.3.3 Objectives of the National Programme: The National Programme for the Control of Blindness, Ministry of Health & Family Welfare, Government of India aims at strengthening India's capacity to provide high volume, high quality and low cost eye care by upgrading health and management skills for eye care personnel and to improve the service delivery. It aims at promoting mobile eye care as well as fixed facilities in service delivery.

The National Programme desires to promote a three tiers service delivery model for diagnosis and treatment of patients:

- a. Primary care at block and village levels by Medical Officers, Ophthalmic Assistance, Health Assistants and Health Workers;
- b. Secondary care including cataract operations at District Hospitals, Sub-district Hospitals/Community Health Centres (where Ophthalmic surgeons posted) and through mobile camps; and
- c. Tertiary care in Regional Institutes of Ophthalmology and Medical College Hospitals.

The National Programme desires the medical colleges to emerge as referral centres for tertiary ophthalmic care in the region, to train ophthalmic personnel and to monitor activities under the national programme. It desires the District Hospitals to provide secondary eye care services, trained personnel and medical officers. Similarly, it desires to upgrade sub-district hospitals as well as community health centres as permanent eye camp sites for Government, Non-Government as well as private ophthalmologist engaged on service contract basis.

Thus the main objective of the National Programme would be to improve the quality of cataract surgeries and reduce prevalence of blindness by reducing the cataract backlog through multipronged strategy.

7.2.4 Type of Cataract Surgery : There is no preventive or medical cure known for cataract. It can occur at any age but is most commonly seen as aging process in adults of 45-50 years or more. It gradually leads to progressive diminution of vision in both eyes and ultimately blindness and is associated with eye problems. However, if cataract is removed surgically, complete eye sight can be restored.

7.2.4.1 Simple surgery: Cataract can be cured by a surgical operation in which the opaque lens is removed which allows the light to reach the retina. Spectacles, contact lens or intraocular lens may then be provided to compensate for the power that is lost after the removal of lens.

7.2.4.2 IOL (Intraocular Lens) Implant: These are made of an inert plastic material called polymethylmethacrylate (PMMA). The IOL lens is permanently implanted in the eye at the time of cataract removal. It usually does not require to be renewed anytime in life thereafter.

Advantages of IOL

- (a) Person achieves workable vision within one or two weeks as compared to three months in case of simple surgery.
- (b) Person may not require glasses for distant vision but for near vision, glasses are required.
- (c) Excellent mode of treatment for unilateral cataract, particularly in children who develop cataract due to trauma.
- (d) Excellent quality of vision, almost near to normal.
- (e) The field of vision is near normal.
- (f) Disturbing optical aberrations as seen with glasses are completely eliminated.

Limitations: IOL implant is a specialized surgery to be performed by the trained Ophthalmologists only. It requires increased manipulation during surgery with the possibility of greater complications. It also requires sophisticated instruments e.g. microscope etc. It is more expensive as compared to simple cataract surgery.

7.2.4.3 Phaco technique : a. Beginning - Dr. Charles Kelman of New York performed the first human phacoemulsification operation. Though accepted with great enthusiasm initially, phacoemulsification had to be abandoned by many surgeons because it was difficult to perform. Moreover, the large size of IOLs available at that time required that a very large wound be made to accommodate the lens. Enthusiasm for phacoemulsification resurfaced in early 1990s, with the development of small incision IOLs, improved phacoemulsifiers and highly effective viscoelastics.

b. Procedure : “In the bag” or “in-situ” phacoemulsification in the posterior chamber is the currently practiced and generally accepted technique. In this technique, immediately before proceeding to emulsify the nucleus, visco-elastic is injected

into the anterior chamber. Most of the nucleus is then emulsified in the capsular bag, using the phaco probe. The the epinucleus is removed and the cortex evacuated.

c. Advantages : Phacoemulsification surgery performed through a small incision has several advantages:

- less induced systemic and ocular complications
- much reduced post operative astigmatism
- more rapid and complete visual and systemic rehabilitation

d. Limitations : The limitations of this procedure include:

- its enormous costs
- the long and difficult learning curve
- severity of complications in the absence of high technological back-up

At present, the cost of this technique is exorbitant. Its success would depend upon cost effectiveness of the procedure.

7.3 Prevention and Cure of Trachoma

a. Causes

- *Caused by an organism chlamydia trachomatis.*
- *1/5 of the inhabitants of the world are effected by this disease.*
- *It is the single largest cause of blindness.*
- *Spreads by contact from one person to another through dirty hands, contaminated towel, and the like*
- *Flourishes among people whose surroundings are unhygienic and who are crowded together in an unhealthy environment where there is:*

- * *lot of dust*
- * *scarcity of water*
- * *poor sanitation*
- * *many flies*
- * *open and dirty latrines*
- * *open drainage and the like.*



Photo : John DC Anderson

Source :Ophthalmology Section, Directorate General of Health Services (1996), National Programme for Control of Blindness, P. 14.

Fig. 2.6(a) : Mild Red Watery Eyes

It is contagious in its acute stages, being spread by the transference of conjunctival secretion by fingers or towels, by flies etc.

7.3.1 Primary infection is epithelial and involves both conjunctiva and cornea.

a. Symptoms

- *Redness*
- *Itching*
- *Tearing*
- *Irritations*

b. Signs : *Diffused conjunctival inflammation characterized by congestion, formation of follicles on the inner aspect of the upper lid. At a later stage, a trachomatous pains or vascularisation of the upper margin of cornea takes place. Corneal ulcers are commonest at the advancing edge of the pumas.*

c. *Treatment*

- *Clean the eyes if there is discharge*
- *Sulphacetamide eye drops 10% or 20% to be instilled at least 4 times a day for 6 weeks.*
- *Advise on personal hygiene and daily washing of face.*
- *Check other members of the family for trachoma*
- *Never use medicines containing steroids.*

7.3.1. *Trichiasis* : Apart from the results of pumas and corneal ulceration, the most malign effects of trachoma are caused by distortions of the lids. There is always some scarring and the shape of lids, especially upper lid, is altered and may be turned inwards, leading to entropion. This causes the lids to rub against the cornea. The condition of misdirected eyelashes is called trichiasis.



Photo : John DC Anderson

Source :Ophthalmology Section, Directorate General of Health Services (1996), National Programme for Control of Blindness, P. 14.

Fig. 2.6(b) : Follicles on Eye

a. *Symptoms*

- *Irritation*
- *Photophobia*
- *Tearing*
- *Poor vision*

b. *Signs*

- *Thickening or distortion of upper lid*
- *Eyelashes rubbing on cornea*
- *Cloudy appearance of cornea*

d. *Treatment*

- *Remove misdirected eyelashes*
- *Use of drugs - Tetracycline, Erythromycin, Rifampicin and Sulfonamides are effective when given systematically but have many side-effects.*

Topical treatment with Erythromycin ointment, Tetracycline or Rifampicin is far more effective than Sulfonamides. This treatment must be persistent for 5 consecutive days a month for 12 months. Oral Doxycycline 5mg/kg body weight one per month is easy to administer and is as effective as topical Tetracycline.

Further treatment may be required in the form of surgical correction of lid deformity.

7.4 Prevention and Cure of Glaucoma : Glaucoma, popularly known as Kala Motia or Neela Motia is a serious killer of eyesight. Nearly one in 10 persons in the world is visually impaired due to Glaucoma. As per Dr. N. N. Sood, nearly 100-150 million Indians over the age of 40 years are in the vulnerable age-group and it is likely that nearly three million either have Glaucoma or are potential candidates.

a. *Complaint*

- Acute glaucoma strikes suddenly with intense pain, nausea and blurred vision*
- Chronic glaucoma*
 - *often called the ‘sneakthief of sight’*

- *works slowly and progressively and can destroy vision almost without warning*

b. Signs

- *An occasional vague headache or aching about the eyes*
- *An occasional blurring or cloudiness of vision*
- *An occasional watering of eyes*
- *Frequent and unsatisfactory changes of glasses*
- *Haloed (rainbow rings around bulbs and headlight of vehicles) appear towards evening or when the individual is disturbed*
- *Diminished side vision*
- *Occasionally difficulty in night vision*
- *May produce a permanent loss of vision within a few hours to weeks and needs emergency treatment.*

c. Causes

- *A nearly constant fluid level is maintained inside the eye*
- *Due to disturbance in the drainage system, fluid can no longer drain away as fast as it is produced*
- *Pressure builds up and eyeball tends to get harder*
- *Pressure pushing against the optic nerve destroys these nerve fibres slowly producing a hollow space called ‘cupping of the disc’ and it destroys sight.*

d. Detection

- *Everyone over 35 should visit an eye doctor for an eye check-up*
- *The most common method of checking for glaucoma is with a tonometer*

e. Treatment

- *Glaucoma is a treatable condition*
- *Treatment is aimed at lowering the internal pressure in the eye*
- *Special eye drops used regularly would maintain the internal pressure at the proper level*
- *In some instances, surgery may be required*

f. Points to remember

- Glaucoma can be halted but not cured and continuing treatment is necessary.*
- It can destroy sight with little or no early warning.*
- Doctor can usually detect glaucoma before any sight is lost.*
- Vision lost because of glaucoma can never be restored*
- Since it is life long problem, periodic visits to specialists are essential*

g. Beware, if you

- *are over 35 years of age*
- *have blood relatives who have Glaucoma*
- *have diabetes*
- *asthmatic and patient of arthritis on long term oral “Corticosteroids”*
- *use cortisone medication*
- *have rainbow rings around bulbs, lights or candles*
- *pain or blurring of sight in the evenings*
- *children with large eyes.*

7.5 Prevention and Cure of Diabetic Retinopathy : Diabetic retinopathy has been a leading cause of blindness and is gaining unprecedented proportions in the developing countries. Just three decades ago it was considered ‘not preventable’ and

'relatively untreatable'. The timely application of laser photocoagulation could reduce visual loss from diabetic macular oedema.

a. *Occurrence* : Diabetic macular oedema occurs in approximately 10 percent of all diabetics. In patients with diabetes for 20 or more years, incidence increases to 25 percent.

b. *Definition* : Macular oedema is defined as any retinal thickening of or deposition of hard exudates within one disc diameter of the centre of the macula. It is termed significant if any of the following three characteristics are present:

- *Thickening of the retina at or within 500 u of the centre of fovea*
- *Deposition of hard exudates associated with the area of adjacent retinal thickening at or within 500 u of the foveal centre*
- *Development of a zone of retinal thickening one disc diameter or larger.*

c. *Detection*

- *Through the use of slit beam with a fundus contact lens.*
- *Subtle amounts retinal thickening can be distinguished, and presence of hard exudate deposits can be easily identified.*
- *Leakage responsible for retinal thickening can be confirmed angiographically.*

d. *Treatment* : The decision to treat diabetic macular oedema is based entirely on clinical and angiographic findings, independent of patient's visual acuity.

- Focal treatment consists of directing only green argon photocoagulation to all leaking microaneurysms.
- Grid photocoagulation treatment of diffuse leakage is based upon the identification of leakage in the mid-and-late frames of the angiogram, unrelated to focal sites of leakage identified in the early frames.

Only 15 percent patients actually improve in measurable acuity. The goal of treatment, rather, is to preserve the patient's current visual performance. A period of 1-6 months is required for maximum reabsorption of fluid and complete healing.

References :**Directorate General of Health Services** (1992): *Present Status of National Programme for Control of Blindness: India - A Report*, New Delhi, P. 137

Dhull, C. S. (1996): *Clinical Orientation - Common Eye Diseases Causing Blindness in National Programme for the Control of Blindness, Course Material for Training in District Programme Management*, New Delhi: Ophthalmic Section, Directorate General of Health Services, P. 9-14

Gupta, Amod (1997): *Modern Concepts in Management of Diabetic Maculopathy*, Perfect Vision, 1 (1), February, P. 11

Ministry of Health and Family Welfare (1978): *Cataract*, New Delhi: P. 15

Ophthalmology Section, Directorate General of Health Services, Ministry of Health & Family welfare, Government of India: National programme for Control of Blindness, *Policy Norms & Standards Adopted Under World Bank Assisted Cataract Blindness Control project*, New Delhi, P.84

Phacoemulsification Special (1995): Scientific Vision, Volume 8, August, P. 3 and P. 19-20

Sota (Dr.), L. D. (1996): *Cataract, Interocular Lens and Contact Lenses*, Hamari Aankhen, 20 (1), January, P. 4-6

Sight Savers International (Formerly Royal Commonwealth Society for the Blind: *Xero India 1985*.; Mumbai, (July) No. 9, P. 8

Sight Savers International (1990): *India Eye Care Policy*, Mumbai (Mimeographed), Draft No. 27, iv. 90

UNICEF (1983) *Early Intervention With Young Visually Handicapped Children*, No. 8

Ward, Majorie E. (1986): *The Visual System*, in Scholl, Geraldine T., *Foundation of Education for Blind and Visually Handicapped Children and Youth*, New York: American Foundation for the Blind, P. 35-64