

Ophthalmology

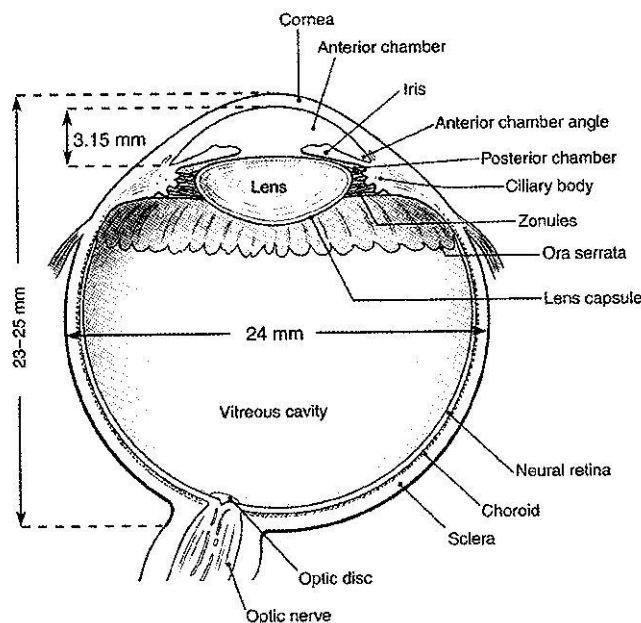
Introduction

Dr.Abdulmmelik shallal

Gross Anatomy of the eyeball:

The eyeball lies in a quadrilateral pyramid-shaped bony cavity situated on either side of the root of the nose called Orbit. Each eyeball is suspended by extraocular muscles and their fascial sheaths in to the bones of the orbit. The eyeball surrounded by a pad of fat to provide a protective cushion. At birth the eyeball measures antero-posteriorly about 17.5 mm and reaches 23-25 mm in adult. The average transverse diameter of the adult eye is 24 mm.

The globe has 3 main layers (coats), each of which s further divided:



1- The outermost tunic (coat): consists of anterior one-sixth transparent part-the cornea and the remainder five-sixths opaque part-the sclera. The transitional junction area is – the limbus. The radius of curvature of the cornea (7.8 mm) is smaller than that of the sclera (12 mm), making the shape of the globe an oblate spheroid. (see the above figure)

Function: the function of sclera is protection of intra ocular contents and also it facilitates the insertion of external ocular muscles. Posteriorly, Sclera contains many perforations and orifices for entrance and exit of vessels and nerves including the optic nerve. The function of cornea is to refract light on the retina and it is even more important than lens in focusing light on the retina.

2- The middle coat (uvea or uveal tract): consists of the posterior part which is called the Choroid, a triangular shape muscular thickening called ciliary body and anteriorly, diaphragm like structure called the iris. The iris perforated centrally by regular and round opening called the pupil.

Function: Choroid, is nourishment to the outer 1/3rd of the thickness of retina. The Ciliary body is secretion of aqueous humor and accommodation. The iris is to determine the size of the pupil in order to determine the amount of light enter the eye through the pupil and also gives the eye its color.

3- The inner coat: light sensitive layers, called retina, composed of 10 layers, the inner 9 layers called sensory retina and outer one layer called retinal pigment epithelium (RPE). There is a deep yellowish-color area at the center of retina called macula lutea (lutea = yellow), the center of macula lutea is called fovea centralis, which is the most sensitive point in the retina.

Retina has two types of photosensitive cells, cones and rods. Fovea centralis contains only cones which is responsible of sharp day and color vision, while rods are responsible for night & peripheral vision.

- **The lens:** is crystalline and transparent structure suspended in its position through the Zonule to the epithelium of Ciliary body.
- **Function:** with the cornea forming the major refractive system of the eyeball that converge light to focus on the retina. (the Cornea forming 2/3rd of the power of the this system while the lens forming 1/3rd)

The eye encloses 3 cavities

1- The anterior chamber: mushroom like cavity located between the cornea anteriorly and iris diaphragm posteriorly. It is about 3 mm in deep, with an average volume of 250 μ L.

2- The posterior chamber: small slit cavity located between iris diaphragm anteriorly and the lens and its zonules posteriorly. It has average volume of 60 μ L.

The anterior chamber and posterior chamber communicate through the pupil and both of them located in the anterior segment (the lens and all structures anterior to it) of the eyeball and both of them filled with fluid called Aqueous humor. The Aqueous humor is secreted by superficial non-pigmented epithelium of the Ciliary body into the posterior chamber and then it is passes to the anterior chamber through the pupil. In the angle of the anterior chamber there is sieve like structure called trabecular meshwork, from here the aqueous humor goes to the circular venous canal called schlemm's canal and from it to the episcleral veins and then to systemic circulation again. The rate of secretion

of aqueous humor is equal to the rate of drainage so that the intraocular pressure (IOP) is constant between 10-21mmHg.

3- The vitreous cavity: it is the largest one, located between lens and zonules anteriorly and adjacent sensory retina posteriorly, filled with jelly-like substance called vitreous humor. It comprises more than two-thirds of the volume of the eye (5-6 mL). the total volume of the average adult eye is approximately 6.5-7 mL.

Posterior segment of the eyeball includes all structures posterior to the lens (vitreous cavity, retina, optic disc and choroid)

Blood supply of eyeball

The arteries of the eye are derived from the ophthalmic artery; a branch of internal carotid artery.

The inner 2/3rd of retinal thickness tissue gets its blood supply from the central retinal artery, a branch of ophthalmic artery, which enters the optic nerve about 10 mm behind the eyeball.

The veins of retina do not accurately follow the course of the arteries, except at the optic disc where they join to form the central retinal vein which accompanies the central retinal artery.

The Central Retinal Vein drains the blood to the cavernous sinus.

The Uveal tract is supplied by three groups of ciliary arteries; all of them are branches of ophthalmic artery.

1. Short posterior ciliary arteries which are 20 in no.
2. Long posterior ciliary arteries which are 2 in no.
3. Anterior ciliary arteries are derived from 7 muscular branches of ophthalmic artery.

The venous drainage of the Uveal tract occurs through the ciliary veins which form 3 groups:

1. Posterior ciliary veins.
2. Vortex veins.
3. Anterior ciliary vein.

The bulk of the blood is drained through the vortex veins comprising 4 large trunks which open into superior and inferior ophthalmic veins, then to cavernous sinuous.

Nerve supply of eyeball:

The sensory nerve supply to the eyeball is derived from the ophthalmic division of the fifth cranial nerve (trigeminal).

The parasympathetic (visceral fibers) innervations to the eyeball derived from oculomotor nerve to supply the sphincter pupillae and ciliary muscles. Sympathetic innervations to the eyeball derived from superior cervical ganglion and then with Internal Carotid Artery and its branches to the eye.

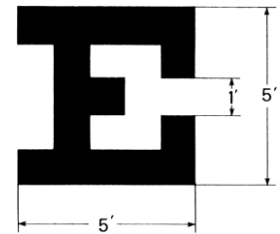
Visual Acuity:

Definition: it is the ability of the eye to distinguish the shape of symbols such as letters, numbers and pictures. By other word it is the **resolving power of the eye**. It is the cone function of the fovea centralis.

VA is designated by two numbers:

1st- Numerator: indicates the distance separating the test object from the patient.

2nd- Denominator: indicates the distance at which the test object subtends an angle of 5 minutes of arc, and each part of the test object subtends an angle of 1 minute of arc.



The most familiar test objects are letters or numbers black in color drawing in a white checkboard, which is uniformly illuminated. This test is called visual acuity charts, the standard Snellen's and Bailey-Lovie charts.

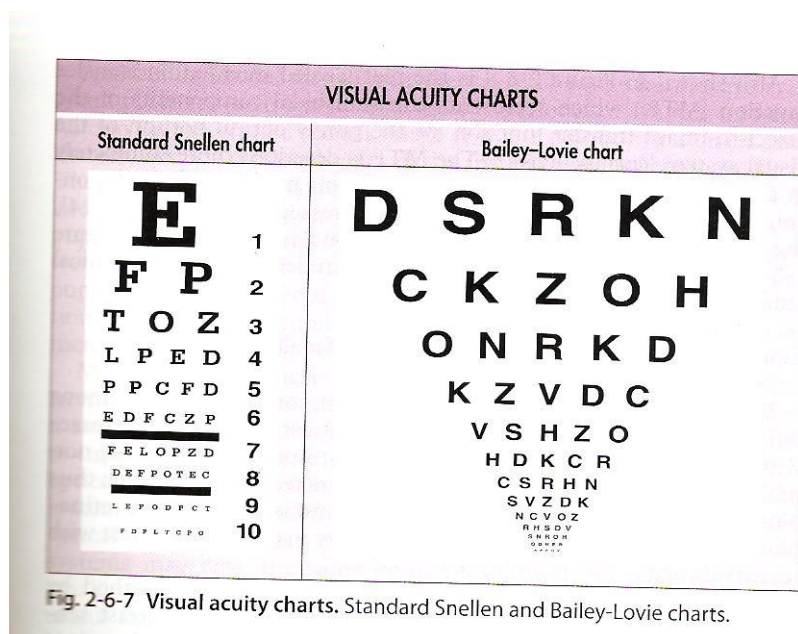
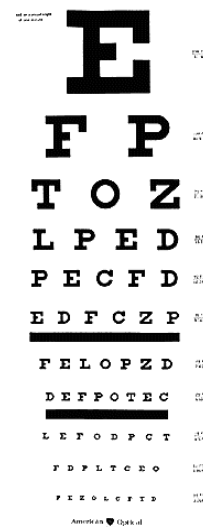
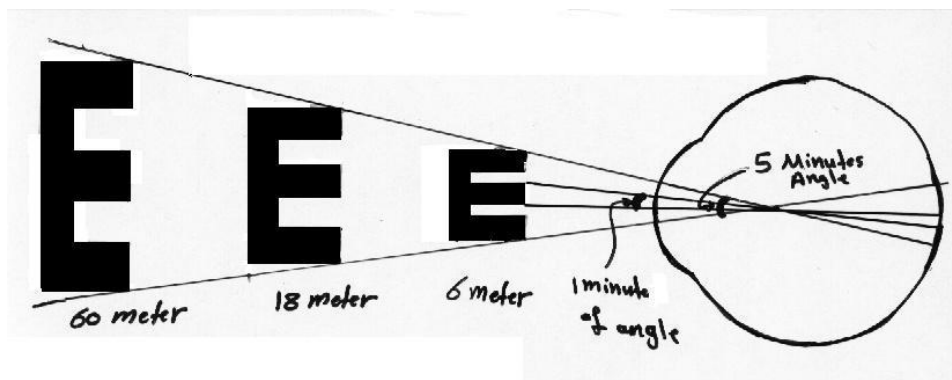


Fig. 2-6-7 Visual acuity charts. Standard Snellen and Bailey-Lovie charts.

Test letters require a literate and cooperative observer. The letters vary in their recognizability. Thus, "L" is the easiest letter and "B" is the most difficult. So the **Landolt broken ring (C)** in which the break subtends a 1 minute angle and the entire ring subtends a 5 minutes angle, eliminates this variability.

Similarly, the letter "E" may be arranged so that it faces in different directions. This letter used for illiterate person.



* For any object to be seen and discriminated by the eye, it must be (at least) able to stimulate 2 cones and leave one unstimulated cone in between. Each cone is 0.004mm in length (4 μ m) and makes an angle of 20", so we need 3 cones to make 1'

VA: $\frac{6}{6}$ for normal person.

1st (upper): 6 \rightarrow represent the distance separating the test object from the patient.

2nd (lower): 6 \rightarrow represent the distance at which the test object subtends an angle of 5 minutes of arc, and each part of the test object subtends an angle of 1 minute of arc.

VA: $\frac{6}{18}$ if the patient can see and recognize the fourth line (size 18).

* in examination of the visual acuity of the patient by snellen's chart, we ask him about the test object in the first line (size 60), if recognize it well, we go downwards, but if he was unable, so we start to take the patient closer to the chart meter by meter, so if he see the first line at 5m, 4m, 3m, 2m or 1m, it is 5/60, 4/60, 3/60, 2/60 or 1/60 subsequently.

If the patient till now can't recognize the test object then we shift to counting fingers then hand movement and then to light projection by applying light in different directions and ask the patient to tell us what is the direction the light is coming from, if he can't determine the direction, then we shift to light perception by asking the patient if he is seeing the light, if no light perception then say it is blindness.

Color vision:

Most normal humans have 3 types of cones and consequently a 3-variable color-vision (3 cone opsins) system. These 3 types are:

- 1- Middle wavelength sensitive (M) cones for detecting high resolution achromatic (black and white) contrast.
- 2- Short wavelength sensitive (S) cones used only color by comparing its signals with those of the M cones. This mechanism creates blue/yellow color vision.
- 3- Long wavelength cones (L) which are creates red/green color vision.

Color vision deficiencies occur as a **hereditary** defect in about 7% of men and 0.5% of women. They are usually transmitted as an *X-chromosome linked* abnormality.

Color vision deficiencies can be *autosomal*, e.g. congenital achromatopsia & cone degeneration.

Color vision abnormalities can be **acquired**:

- 1- Retrobulbar neuritis.
- 2- Foveal degeneration caused by vascular disease.
- 3- Retinal detachment (involving the fovea).

Visual field:

Definition: Island of vision in sea of darkness.

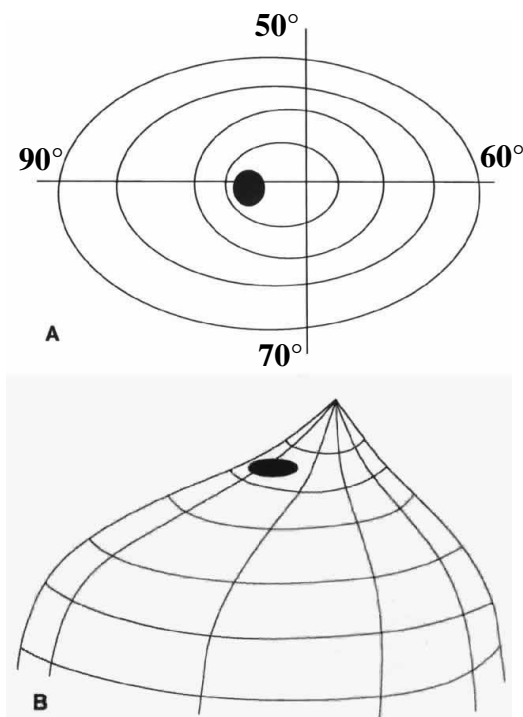
The function of the extrafoveal retina is assessed by measurement of the visual field when the ability to recognize the special target diminishes rapidly in all directions away from the fovea centralis.

The macula also can be assessed through performing central visual field, so we have 2 types of visual field:

- 1- Central visual field (macular) → central 30°.
- 2- Peripheral visual field (extramacular) → out of central 30°.

The peripheral extension of visual field is:

50° superiorly (limited by eye brow), 60° nasally (limited by nose), 70° inferiorly (limited by cheek) and 90° temporally (no limitation).



Assessment of peripheral visual field by:

- 1- Confrontation visual field.
- 2- Goldmann visual field.
- 3- Automated and computer-assisted perimeters.

Assessment of central visual field by:

- 1- Goldmann visual field.
- 2- Automated perimeter.
- 3- Tangent screens.
- 4- Amsler grid.
- 5- Friedmann perimeter.

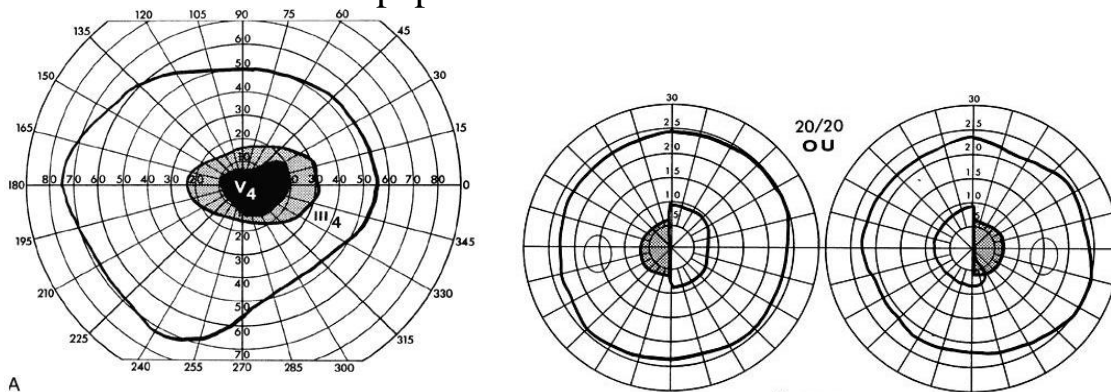
Interpretations of visual field abnormalities:

- **Mono-ocular VF defect:** Disease involving retina and optic nerve.
- **Binocular VF defect:** Disease involving the optic chiasma, optic tract, optic radiation and occipital cortex.

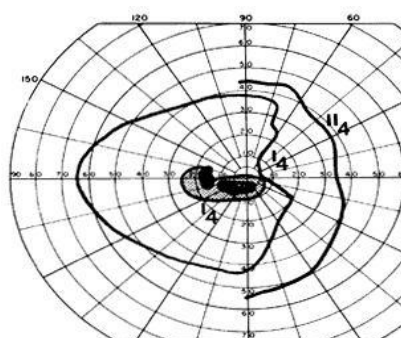
Defects in the VF are usually described as:

- 1- Central (within central 30°).
- 2- Peripheral (outside central 30°).

- **Central VF defect (central scotoma):** characterized diseases involving the fovea centralis and the papillomacular bundle of nerve fibers in the optic nerve.

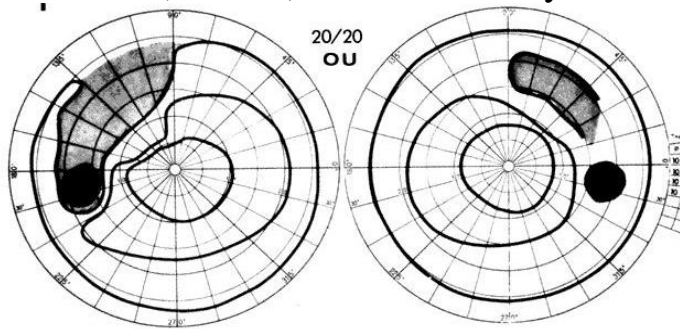


- **Centrocecal scotomas:** involve both, physiological blind spot and fixation point, e.g. toxic diseases of the optic nerve.



- **Annular scotoma:** e.g. retinal pigmentary degenerations (retinitis pigmentosa), advance glaucoma, and senile miosis of pupil.

- **Arcuate (arched) scotoma:** Early Glaucoma.



- **Hemianopia:** half-blindness, left and right retina of opposite side.

- **Homonymous hemianopia:** binocular right or left Homonymous hemianopia.

- **Heteronymous hemianopia:** Binocular, right from one eye and left from other.

Usually we use either bitemporal or binasal heteronymous hemianopia.