How Does The Eye Work

- The eye is like a camera.
- Light comes in through the cornea, a clear cover that is like the glass of a camera's aperture.
- The amount of light coming in is controlled by the pupil, an opening that opens and closes a little like a camera shutter.
- The light focuses on the retina, a series of light-sensitive cells lining the back of the eye.
- The retina acts like camera film, reacting to the incoming light and sending a record of it via the optic nerve to the brain.
- The Eye produce bioelectric signal such as EOG & ERG

The electroretinogram ERG

The global or full-field electroretinogram (ERG) is a mass electrical response of the retina to photic stimulation.

The intense flash of light elicits a biphasic waveform recordable at the cornea.
ERG

Two principal measures of the ERG waveform are taken: 1) The amplitude (a) from the baseline to the negative trough of the a-wave, and the amplitude of the b-wave measured from the trough of the a-wave to the following peak of the b-wave; and 2) the time (t) from flash onset to the trough of the a-wave and the time (t) from flash onset to the peak of the b-wave.

ERG recording electrodes

There are a number of corneal ERG electrodes that are in common use. Some are speculum structures that hold the eye open and have a contact lens with a wire ring that "floats" on the cornea supported by a small spring. Some versions use carbon, wire or gold foil to record electrical activity.
Electro-Oculogram (EOG)

The clinical electrooculogram is an electrophysiological test of function of the outer retina and retinal pigment epithelium in which the change in the electrical potential between the cornea and the ocular fundus is recorded during successive periods of dark and light adaptation.

Today the recording of the EOG is a routinely applied diagnostic method in investigating the human oculomotor system.

The application of digital computers has considerably increased the diagnostic power of this method.

Electrophisiology of RPE in dark and light adaptation

Emil du Bois-Reymond (1848) observed that the cornea of the eye is electrically positive relative to the back of the eye.

Elwin Marg named the electrooculogram in 1951 and Geoffrey Arden (Arden et al. 1962) developed the first clinical application.
**EOG**

This positive potential behaves as if it were a single dipole oriented from the retina to the cornea. Such corneoretinal potentials are well established and are in the range of 0.4 - 1.0 mV.

Eye movements thus produce a moving (rotating) dipole source and, accordingly, signals that are a measure of the movement may be obtained.

The chief application of the EOG is in the measurement of eye movement.

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**Measuremant of the clinical EOG**

The calibration of the signal may be achieved by having the patient look consecutively at two different fixation points located a known angle apart and recording the concomitant EOGs.

By attaching skin electrodes on both sides of an eye the potential can be measured by having the subject move his or her eyes horizontally a set distance.

Typical signal magnitudes range from 5-20 µV/°.
Measuremant of the clinical EOG

A ground electrode is attached usually to either the forehead or earlobe. Either inside a Ganzfeld, or on a screen in front of the patient, small red fixation lights are placed 30 degrees apart. The distance the lights are separated is not critical for routine testing.

Measuremant of the clinical EOG

The standard method

Fig. 44: Measurement of the electrodes for recording an EOG.

Fig. 46: Ganzfeld used for stimulating EOG recordings.

Fig. 45: Normal EOG recording.
**Eye Pressure**

- Intraocular pressure is mainly determined by the coupling of the production of aqueous humor from the eye's ciliary body and its drainage through the trabecular meshwork and Schlemm's canal located in the anterior chamber angle.
- Current consensus in ophthalmology defines normal intraocular pressure as that between 10 mmHg and 20 mmHg.
- Intraocular pressure is an important indication of glaucoma, a disease that can lead to blindness.
- Sometimes the extra high intraocular pressure causes the collapse of tiny blood vessels that nourish the light-sensitive cells of the retina and the optic nerve fiber.

**Eye Pressure**

- Intraocular pressure cannot be measured unless we insert a cannula into the eyes.
- Clinically, intraocular pressure is measured indirectly by measuring the ocular tension → tonometry.
  → Applanation tonometry: measures the force required to flatten a standard area of cornea.
  → Indentation tonometry: measures the formation of the globe in response to standard weight applied to the cornea.

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**Ophtalmoscopy**

- Gonioscopy: observe the anterior chamber angle.
- Ophtalmoscopy (funduscopy): evaluate the color, configuration of the cup and neuroretinal rim of the optic disk.
- Ophtalmoscopy is used to inspect the interior of the eye, it permits visualization of the optic disk, vessels, retina, choroid (layer of blood vessel behind the retina), and ocular media.
- Ophtalmoscopy → direct Ophtalmoscopy & indirect Ophtalmoscopy.
Ophtalmoscopy

- **Direct ophthalmoscope**
  It is an instrument about the size of a small flashlight (torch) with several lenses that can magnify up to about 15 times. This type of ophthalmoscope is most commonly used during a routine physical examination [2].

- **Indirect ophthalmoscope**
  An indirect ophthalmoscope constitutes a light attached to a headband, in addition to a small handheld lens. It provides a wider view of the inside of the eye. Furthermore, it allows a better view of the fundus of the eye, even if the lens is clouded by cataracts [2].

An indirect ophthalmoscope can be either monocular or binocular.

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![Figure 7.16](image.png)

*Figure 7.16 In indirect ophthalmoscopy, the examiner stands in front of the patient and holds the condensing lens at an appropriate distance from the patient’s eye.*
These yellow flecks are called hard exudates. They are the lipid residues of serous leakage from damaged capillaries. The commonest cause is diabetes. Other causes are retinal vein occlusion, angiomas (Von Hippel-Lindau Disease), other vascular dysplasias, and radiation-induced retinal vasculopathy.

Visual Field

- The visual field refers to the total area in which objects can be seen in the side (peripheral) vision while you focus your eyes on a central point.

Visual Field test

- Why measure fields?
  Understanding of functional abilities.
  Help diagnose a vision/brain condition.
  Monitor treatment/progression of condition.

- What are we looking for?
  Relative field defect/scotoma - a light target can be seen but only when it is made brighter or larger (that is, reduced sensitivity).
  Absolute defect/scotoma - No response to a stimulus regardless of brightness or size (definitive absence of processing from this area).

- Perimetry - measure of the visual field

• Normal Adult dimensions
  50-60 deg superiorly
  70-75 deg inferiorly
  60 deg nasally
  90-100 deg temporally

• Central and Peripheral components
  Division of Labour - Central Field
  highly developed area of the retina responsible for detailed vision, read, recognise faces, detect colours.

• Peripheral Field
  specialised in the detection of motion signals, enables safe navigation around our environment.
• Perimetry - measure of the visual field
• Two ways to measure the visual field.
  Similarities are
  a) patient keeps eyes fixed on a target straight ahead
  b) presented with light stimulus
  c) they indicate by pressing a buzzer that the image is visible
  Differences are
  Static testing
  light source is flashed from a stationary point within the visual field
  light source can vary in brightness (luminance level)
  computerised