2nd term – Lect. (Ophthalmic System)

1- Ophthalmoscope, Direct

Purpose

The ophthalmoscope is a popular instrument designed to enable the doctor to visualize the interior of the eye by placing it close to the subject's eye and viewing an upright magnified image. The ophthalmoscope is the most frequently used ophthalmic instrument for any optician, optometrist, or ophthalmologist. It is an essential device for the examination of the retina and the vitreous humour, the gelatinous liquid between the retina and the lens. Although the instrument is simple, the conditions that an ophthalmoscope can detect are diverse. Almost everyone who has ever had an eye examination has come into contact with an ophthalmoscope.

Principle

There are two main types of ophthalmoscopes, direct and indirect. Direct ophthalmoscopes are simple handheld ophthalmic instruments consisting of a concave mirror, a light source, an eyepiece, and a simple handle. A variable light source illuminates the eye and the image is viewed through a magnifying lens. It contains a set of lenses used to focus on the various structures of the eye. The lens is selectable either within the unit or by exchanging eyepieces. The unit is handheld with internal batteries. The functioning of the instrument is shown in Figure 1.

The device is held in front of the patient's eye, and the operator looks through one of the small lenses into the eye to view the appearance of the cornea, the lens, the aqueous and vitreous humour, and the surface of the retina. The view provided by the ophthalmoscope is monocular, non-stereoscopic (2D) and

narrow field (5º) and is magnified reticular about 15x. The image is upright and unreversed.

The instrument illuminates the subject's fundus by light reflected off a mirror on the instrument head. A perforation in the centre of the mirror helps the observer view the area illuminated. The emanating rays from the subject's eyes are parallel, assuming the subject is normal sighted. These rays are converged to a focus by the observer's cornea and crystalline lens onto the observer's retina. The emanating rays from a myopic subject's eye would be convergent and therefore will require a concave lens to make it parallel before entering the observer's eye and the converse if the subject is hyperopic. These lenses are mounted on a wheel on the ophthalmoscope head, which can be appropriately dialled. The various parts or controls on a typical ophthalmoscope are shown in Figure 2.

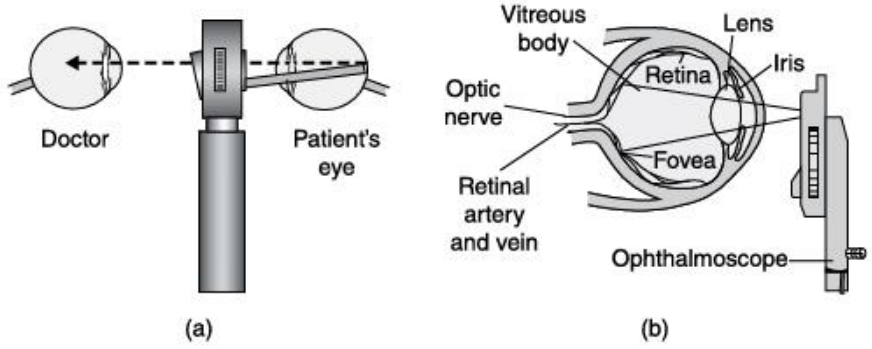

Figure 1 (a) Direct ophthalmoscope. (b) Principle of working of a direct ophthalmoscope.

Figure 2 Various controls on a typical direct ophthalmoscope.

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Specifications

1- Illumination: 3.5 V, 2.8 W mini-halogen/xenon halogen lamp

2- Input power: 8 VA battery

3- Viewing lenses: Not smaller than -20 D to +20 D with 1 D steps
magnification: up to x15

4- Filters: Red-free, blue, and polarization filters.

5- Apertures: Large spot, small spot, slit, central net, and red-free

6- Total weight: 340 g

Applications

Direct ophthalmoscopy is a useful clinical tool, which is a part of every clinician's examination routine. It is used for examination of the ocular fundus, which is an important component of the clinical evaluation in many diseases. However, it has its limitations that can usually lead to appropriate referrals and more detailed evaluations.

2. Opthalmoscope ,Indirect

Ophthalmoscope, Indirect

Purpose

An indirect ophthalmoscope provides a wider view of the inside of the eye and allows a better view of the peripheral retina. It provides its clearer view through lens opacities due to cataract conditions even when the lens is clouded by cataracts, which is not generally possible with a direct ophthalmoscope. It is thus an invaluable tool for diagnosis and treatment of retinal tears, holes, and detachments.

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Purpose

A simple direct ophthalmoscope may be used when a patient comes up for a simple eye check-up, but to a patient having more serious eye conditions, the binocular indirect ophthalmoscope is required for better and more accurate diagnosis. The technique of indirect ophthalmology is called indirect because the fundus is seen through a condensing lens. The image is formed close to the principal focus of the lens, between the lens and the observer. The optical ray diagram of an indirect ophthalmoscope is shown in Figure 1.

It produces an inverted, or reversed, direct image of two to five times magnification of the object under observation. It has a stronger light source, a specially designed objective lens, and provision for stereoscopic inspection of the interior of the eyeball. An indirect ophthalmoscope can be either monocular or binocular. Monocular indirect ophthalmoscopes have a high level of magnification and a wider field of view than a traditional direct ophthalmoscope, but they only offer one view of the interior of the eye. In order to accurately assess a patient's fundus and ocular condition, it is required to look in multiple directions. Binocular indirect ophthalmoscopes project three elements into the eye, rather than one, allowing a three-dimensional (3D) rendering of the interior of the eye allowing for a more thorough examination of the eye. These are typically head mounted. Some devices are designed as teaching aids so that senior practitioners can show procedural and diagnostic information to students while conducting the ocular examination. Binocularity is achieved by the use of mirrors in the instrument to reduce the pupillary distance of the observer to about 15 mm. The optical ray diagram of the binocular indirect ophthalmo-scope is shown in Figure.2. The instrument also carries a light source that is attached

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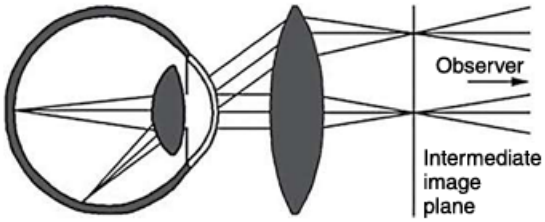

Figure .1 Principle of working of an indirect ophthalmoscope.

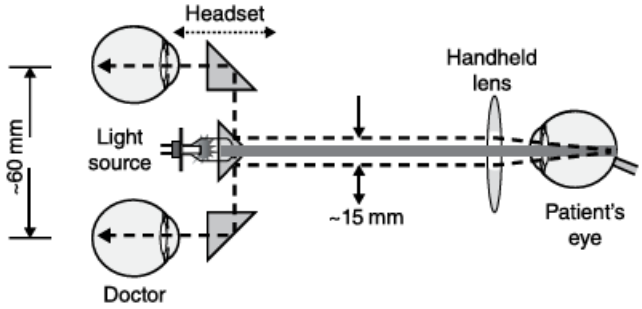

Figure .2 Principle of working of a binocular indirect ophthalmoscope.

to a headband or spectacle frame worn by the examiner. Figure.3 illustrates the various components and controls on an indirect ophthalmoscope. The binocular indirect ophthalmoscope provides a much wider field of view (45")
than a direct ophthalmoscope and allows viewing of almost the entire retina. The view provided by it is stereoscopic (3D), inverted, and illuminated with magnification of about 5x. Some instruments have a built-in video camera to permit eye care professionals in-training to view the examinee. The patient is examined either seated in a reclining chair or lying on a couch. The device is worn as a headset as shown in Figure.4 and is used in conjunction with acondensing aspheric lens held close to the patient's eye. A condensing lens varying from +15 to +30 D is held in one hand of the examiner in front of the patient's eye. The image formed is magnified three-fold with a 20D lens and is inverted and laterally reversed. Lower power lenses provide higher magnification but offer a smaller field of view. Below about +20D, the lens needs to be held further from the patient's eye and may not be comfortable for steady positioning. Lenses of powers greater than +20D are useful for wide field examination, but do not give enough magnification for viewing fundus detail. Headband or spectacle

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indirect ophthalmoscopes with a +20D power lens will provide a magnification of approximately x3 and a static field of view of approximately 40º for an emmetropic (relaxed) eye. The total dynamic field of view can be as much as 240º. Indirect ophthalmoscopes are available with wireless connectivity in which software allows you to use your laptop or any USB interface to optimize the examination, provide still or dynamic images, which aid in the documentation and diagnosis of the patient. Some new indirect ophthalmoscopes are coming as digital versions, which are coupled with integrated cameras that record moving video footage and still images in the digital format. These images can be transferred to a PC via a USB interface and is compatible with any video package capable of receiving video input from a USB source. An advantage of indirect ophthalmoscopy is that it requires a considerable distance between the patient and the observer. This is in contrast to direct ophthalmoscopy, in which close approximation is advantageous. When a patient with tuberculosis and other respiratory infections is to be examined, the use of indirect ophthalmoscopy is recommended.

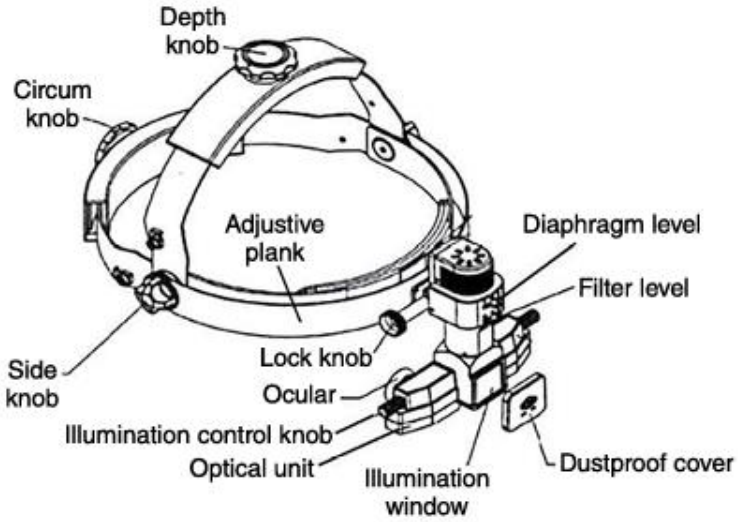

Figure .3 Various controls on an indirect ophthalmoscope.

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Figure .4 Indirect ophthalmoscope in use. *Source:* Courtesy of LV Prasad EYE Institute, India.

Specifications

1- **Light source: Halogen lamp - 6V, 10 W; LED - 3.7V-700 mAh**
2- **Illumination area: Flux 80 mm**
3- **Interpupillary distance: 53-76 mm**
4- **Camera**
5- **Video focusing range: 140 mm-2 m**
6- **Image size: 80 mm**
7- **Resolution: 470 TV lines**

Applications

Indirect ophthalmology test is especially used to detect and evaluate symptoms of various retinal vascular diseases or eye diseases such as glaucoma, headaches due to raised intracranial pressure (ICP) that could be due to hydrocephalus, and benign intracranial hypertension or brain tumour, among other conditions. In patients with diabetes mellitus, regular ophthalmoscopic eye examinations are important to screen for diabetic retinopathy as visual loss due

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to diabetes can be prevented by retinal laser treatment if retinopathy is spotted early. In arterial hypertension, hypertensive changes of the retina closely mimic those in the brain and may predict cerebrovascular strokes.

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