Binocular Indirect Ophthalmoscope

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Binocular indirect ophthalmoscope has become an indispensable tool to diagnose and manage a variety of vitreoretinal disorders. The instrument has a rich history evolving through many generations to yield the current diagnostic marvel. Sophisticated additions to the basic technology include high magnification lenses built in to the ophthalmoscope, video adapters that facilitate patient and student education as well as open up an array of telemedical possibilities and laser photocoagulation systems mounted on to the indirect ophthalmoscope to treat peripheral tears through a 20 diopter lens.

The first binocular indirect ophthalmoscope was invented by Marc Antonie Giracid Tenlon of France in 1861. The first reflecting ophthalmoscope was invented by Helmholtz in 1850. Since Helmholtz first described the ophthalmoscope hundreds of variants have been described.

Perhaps the most useful, successful variant of the ophthalmoscope is the binocular indirect headband ophthalmoscope, first described by Charles Schepens in 1945 (Fig 1). It soon became the standard method of clinical ophthalmoscopy by ophthalmologists. They are indispensable in diagnosing and managing vitreoretinal disorders including lattice degeneration, retinal holes or tears, retinal detachment, retinopathy of prematurity, retinoschisis, sickle cell retinopathy and an array of other diseases.

Modern indirect ophthalmoscopes come with a myriad of features, which may include adjustable inter pupillary distance, portable power packs, adjustable mirrors, dust sealed optics and red free and cobalt blue filters. Video capture capabilities built in to some indirect ophthalmoscopes allow the patient to see his or her fundus on video and students also greatly benefit from this feature.

**Optics**

We can see an object only if it lies in line with the observing eye, provided that the object is illuminated. If a flat surface is to be illuminated and visualized, there may be a wide angle between the source of light and the observer. When the access to the object is limited, as in the eye by the pupil, the angle between the source of light and the observer is smaller. The source of light and the observer need to be practically overlapping. The illuminating and observing beams are optically aligned in an indirect ophthalmoscope, to make this possible. When both the illuminating and reflecting beam pass through the pupil, that area of fundus is seen.

The principle of indirect ophthalmoscopy is to make the eye myopic by placing a strong convex lens in front of it. This forms a real inverted image of the fundus in the air between the lens and the observer. The usual powers used are +20 D and +13 D. The lens is...
positioned in such a way that it changes the direction of diverging rays emanating from the subjects’ eye and brings them to a point focus within the pupillary plane of the observers eye. Thus the pupils are in conjugate places.

If the patient is emmetropic, the rays of light from the subjects’ eye are parallel, but this changes once these rays pass through the condensing lens. As the rays of light enter the lens with zero vergence, they are brought to a focus in the focal plane of the condensing lens. Considering all rays of light emerging from the patient’s eye together, an aerial image of the patients’ fundus is formed in the focal plane of the lens (aerial image plane). Beyond this, the rays of light are divergent which are brought into focus by the observed eye. To focus this image on his own retina, the observer must accommodate for the aerial image plane and hence cannot approach too closely.

The magnification of the image is calculated by dividing the power of the eye by the power of the condensing lens. A 20 D lens should give a magnification of 3 times where the power of the emmetropic eye is 60 D. The stronger the power of the condensing lens, the closer it must be held toward the eye, since it is based mainly on the focal length of the condensing lens.

**Procedure**

The patient should be preferably in supine position, with pupils maximally dilated. The patient should be explained about the procedure before hand. Room light should be turned off making sure that all extraneous sources of light are eliminated. The illumination should be kept minimum initially with the beam size maximum and filters out. The headband keeps the indirect ophthalmoscope anchored to the head preventing any further movement. The crown strap rests snugly over the vertex of the head. The headband should fit approximately one finger width above the eyebrow with the rear strap straddling the inion (Fig 2a). The oculars should be as close to the examiners’ pupil as possible and the optical axes kept parallel to the line of the examiners’ vision. The view through both the eyes should completely overlap each other. The mirror should be aligned in such a way that the light is anteriorly directed. The light from the ophthalmoscope should enter the patient’s pupil in a plane higher then the image of the examiners visual axes.

The light should be adjusted in such a way that the vertical portion of the light fills the upper half of the field of view. This adjustment can be done on the back of the fist held at arm’s length or on the eye of the patient.

The interpupillary distance should be adjusted properly to avoid diplopia and achieve stereoscopic view of the fundus image. This can be accomplished by adjusting the oculars which slide horizontally. The oculars should be made to slide approximately in the right direction by the same amount in both eyes till a unified binocular field is obtained. The condensing lens should be held properly to perform various aligning maneuvers of the lens efficiently. The lens should be held with the convex side facing the examiner.

The thumb of the index finger should be diametrically opposite to each other with the middle finger supporting a point on the rim midway between the thumb and the index finger. While the ring and the little fingers rest on the cheek of the patient they can also be used to retract the lid.

The lens can be moved antero-posteriorly, side ways, tilted across the visual axes or tilted across the eye. The lens is moved to and fro in the antero-posterior direction in order to find the correct focal plane. Side to side movement helps to centre the image on the lens and is part of the basic movement for aligning the lens. This movement also helps in verifying the meridional localization of a pathology. Tilting of the lens across the visual axis helps to create a reflex free area through the fundus can be seen clearly. Tilting the lens across the eye helps to shift the viewing area from an area to the adjoining area.

If the image of the fundus is filling only the centre of the lens, the lens should be moved either towards the observer or the patient, till a clear image is obtained. Crescent image formation at the edge of the condensing

![Fig:2 (a and b) Examining the fundus with BIO](image-url)
lens can be avoided by tilting the lens towards the crescent shadow.

Initially the illumination should be kept low with gradually increasing the voltage once the patient has become light adapted. The routine examination begins with superior nasal position of the patient.

The examiner is positioned 180° opposite the patient’s direction of the gaze (Fig 2b). Initially the ophthalmoscope light is directed into the pupil and the red reflex is observed. Then the +20 D condensing lens is inserted into the light path about 2” from the eye. The superonasal area of the fundus of right eye is viewed first by standing to the right of the patient. Then the examiner moves progressively to the head end. The 12 o’clock position corresponds to the head end of the patient and 6 o’clock towards the feet. For the right eye 3 90’clock points to the nose and 9 o’clock towards the right ear. Similarly for the right eye, the 3 o’clock points to the left ear and 9 o’clock towards the nose. This orientation remains the same irrespective of the position of the head. A low power lens (14D) may be used where the distance of the lens from the eyes is sufficiently large to prevent any disturbance from the nasal bridge. To examine the extreme periphery of the fundus, the patient is instructed to move his eyes maximally in the direction to be examined. For viewing through oval pupil in extreme peripheral gaze, the examiner can tilt his head towards either shoulder and view through the widest apparent diameter of the oval pupil. The posterior pole is examined finally by asking the patient to look at the examiner’s ear. By shifting the thumb of the patient on which the patient’s gaze is fixed by the other eye, the examiner can move the eye under observation into various positions of gaze, thereby scrolling the entire posterior aspect of the fundus in detail. The macula should not be exposed to more than 40 seconds of continuous bright light to avoid the risk of the photic injury. The patient should be allowed brief respites for blinking since the lens increases the intensity of light by focusing it onto an area and also to prevent corneal dryness.

The binocular indirect ophthalmoscope gives an inverted image of the fundus. The image is upside down and reversed right for left. Only the image is reversed and not the location of the fundus. The periphery of the fundus is imaged towards the observer or inferiorly as seen in the lens and the posterior aspect is imaged superiorly or away from the examiner. Movement by the examiner in one direction produces a movement of the fundus image in the opposite direction. When the patient moves the eye, the fundus image in the condensing lens also moves in the same direction.

**Colour coding:**

All the fine details of the lesion, for eg. the size of a tear, the direction of the flap, relation to adjacent lesions like, relation to the blood vessels and their branching should be drawn.

**Colour coding for retinal diagrams:**

<table>
<thead>
<tr>
<th>Colour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Retinal vessels, subretinal fluid, detached retina edema</td>
</tr>
<tr>
<td>Red</td>
<td>Attached retina, haemorrhage (preretinal, retinal or subretinal), retinal tears, microaneurysm, panretinal neovascularization, occasionally normal retinal arteriole</td>
</tr>
<tr>
<td>Yellow</td>
<td>Exude, inflammation (retinal), amelanotic</td>
</tr>
<tr>
<td>Green</td>
<td>Media opacity (corneal calcification, cataract vitreous debris or haemorrhage), panretinal fibrosis or preretinal membranes, vitreous detachment (weiss ring)</td>
</tr>
<tr>
<td>Brown</td>
<td>Melanocytic lesions</td>
</tr>
<tr>
<td>Orange</td>
<td>Orange pigment</td>
</tr>
<tr>
<td>Black</td>
<td>RPE (retinal pigment epithelium), pigment clumping, lattice degeneration, melanocytoma.</td>
</tr>
</tbody>
</table>

The technique of scanning in indirect ophthalmoscopy is important to identify the exact orientation of lesions and to get an overall view of the fundus and makes scleral indentation possible. In this technique, the posterior pole of the eye is scanned first. Then rotate a retinal vessel and follow it from the disc to as far anterior as can be readily observed. Then follow the vessel of the disc. This exercise is to be repeated until a continuous scanning portrait of the fundus can be seen.
for all positions of gaze within the eye. This overlapping view review strategy also assures that nothing is missed.

For scleral indentation, the 3 O’ clock and 9 O’ clock positions can be indented by placing the depressor slightly above on the upper lid (2 O’ clock and 10 O’ clock) and sliding the probe downwards to move it into the inner or outer canthal positions. Indentation can also be done by applying the probe to the sclera without the intervening lid, but topical anesthesia should be used to make the patient comfortable.

A better peripheral view can be obtained using +28 D or +30 D lenses.

Cleaning of the condensing lens may be achieved by using hard contact lens cleaner and warm water and then dry with a soft lint free cloth. Sterilization of the condensing lens can be done by placing the lens in cidex for 5-10 minutes, by ethylene oxide sterilization or by placing it in formalin chamber. The lens can also be autoclaved in a steel chamber with perforation for steam.

Advantages of binocular indirect ophthalmoscopy

- The biggest advantage of indirect ophthalmoscopy is the wide field of view. It crystallizes the spatial topography and the relative size, shape and positions of different structures in the fundus.

- Stereopsis is essential for depth perception and a three dimensional reconstruction of an object. The stereopsis rendered by the indirect ophthalmoscope offers an invaluable and unmatched evaluation of the relative plane of different structures and lesions in the fundus.

- The periphery of the retina can be examined only with a binocular indirect ophthalmoscope.

- The binocular indirect ophthalmoscope helps to view the retina through a hazy media.

- Indirect ophthalmoscopy is not affected by the refraction state of the subject’s eye.

In short, binocular indirect ophthalmoscopy opens up a whole new world of exciting clinical images that cannot be appreciated without mastering this technique.

References


