



Binocular indirect ophthalmoscopy

Part 1

In the first of two parts discussing headset BIO, Dr Dan Rosser looks at the development of the instrument and explains how best to use it. CET Module C14386, one specialist point for IP, SP and AS, one general CET point, suitable for optometrists



Recent decades have seen UK optometrists shift away from monocular instruments towards binocular indirect techniques both for routine fundus examination and, in particular, where an enhanced view is required. Formerly the staple instrument of the community optometrist, direct ophthalmoscopy (DO), has given ground to slit-lamp binocular indirect ophthalmoscopy (SBIO) as the technique of choice. Despite the fact that optometrists have embraced the advantages of binocular techniques, head-mounted binocular indirect ophthalmoscopy (HBIO) remains an instrument more associated with ophthalmology than optometry. This article aims to review the design and use of HBIO while the second article will be highlighting indications for its use in optometric practice.

Background

The invention of the HBIO is generally attributed to Charles Schepens who first described it in 1945 (Schepens 1947). Although binocular indirect ophthalmoscopes had been in existence since the 19th century, Dr Schepens developed the head-mounted internally illuminated instrument with which we are familiar today in an attempt to improve the examination of patients with retinal detachment (Figure 1).

Design

The novel element of Schepens' design was the use of a head mounted observation system combined with an internal light source. The observer orientates his/her head such that light from the internal light source is directed into the patient's eye. A positive powered lens is held by the examiner at its focal length from the patient's eye serving two purposes (Figure 2):

The lens 'condenses' light from



Figure 1 The binocular indirect ophthalmoscope

the illumination system towards the patient's pupil (hence the lens is often referred to as a condensing lens)

Light reflected from the retina passes back through the lens creating a real, horizontally and laterally inverted image of the fundus situated between the lens and the examiner.

The observation element of the instrument is a binocular viewing system incorporating a pair of low powered convex lenses. This design affords the examiner a stereoscopic view of the virtual image. The instrument uses a 'reflex-free' system designed by Gullstrand towards the end of the 19th century to minimise unwanted back-scatter and reflections during ophthalmoscopy. The principle is that the path taken by the light from the illumination system entering the eye is separate to the path taken by light emerging from the eye to be imaged by the observation system. By keeping the two pathways separate in the pupillary plane (Figure 3), reflections and back

scattered light are minimised. This feature results in an improved fundus view in the presence of media opacities than is possible with slit-lamp indirect ophthalmoscopy, and in particular in comparison with direct ophthalmoscopy. Many instruments allow the separation between the pathways to be reduced to facilitate a binocular view through small pupils (Figure 3).

The condensing lens

Condensing lenses tend to be biconvex aspheric lenses featuring the majority of their power on the front surface (ie the side facing the examiner). A wide variety of lenses are available (Figure 4) covering a power range of around 15 to 40 dioptres. The choice of lens determines magnification and field of view with higher powered lenses offering less magnification but a larger field of view. The 20D lens is the standard lens for general examination offering X3 magnification and a field of view of approximately 45°. As well as offering a greater field of view and less magnification, higher powered lenses have a smaller diameter and are held closer to the patient's eye (both features which can be advantageous to examiners with small hands). A +30D lens will offer X2 magnification along with a field of approximately 65°. These higher powered lenses are commonly used to examine small children and those with small pupils. They can be thought of as more forgiving than the lower powered lenses, and as such are often advocated as a good choice of lens for those new to HBIO.

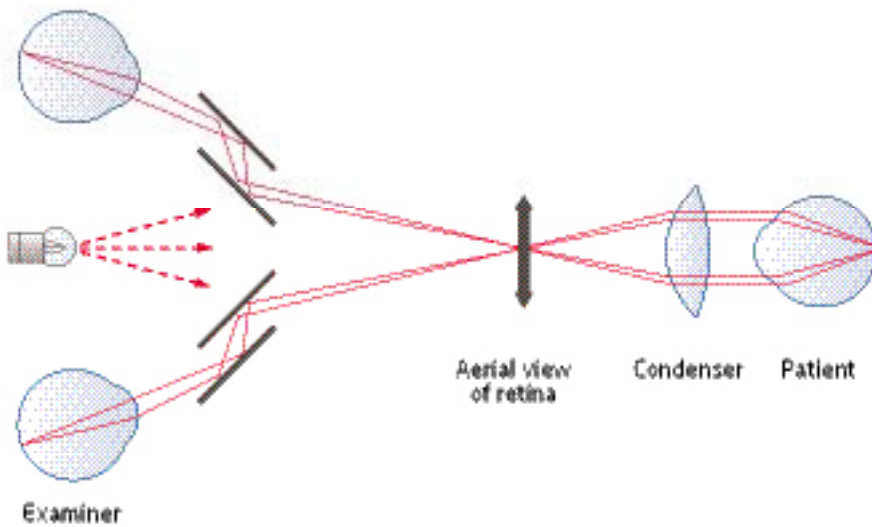
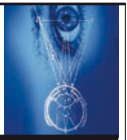


Figure 2 The optics of HBIO. Light from the internal illumination system is focused by the condensing lens and passes through a relatively small region of the patient's pupil

slit lamp either for physical reasons, or where a slit lamp is unavailable eg during domiciliary visits (though recent improvements in portable slit lamps may change this – see future Optician review of such instruments in the coming weeks). It is worth noting that as cycloplegia is often indicated when examining children or patients with learning difficulties, the pupil will already be dilated facilitating a subsequent fundus examination using HBIO.

Disadvantages

Generally requires mydriasis. Although many instruments have a 'small pupil' setting, an undilated pupil makes for a more difficult examination and as such it is generally recommended that those new to HBIO become proficient in the technique on dilated pupils first

The vertically and horizontally inverted image complicates the recording of fundus abnormalities

The level of magnification is relatively low (especially with the higher powered condensing lenses), and as such a detailed evaluation of fundus abnormalities may be less satisfactory than with SBIO which affords a greater degree of magnification

Advantages and disadvantages of HBIO

Advantages

Wide field view of the fundus which is almost completely independent of the degree of ametropia. The field of view with HBIO using a 20D condensing lens is typically around 8 disc diameters compared with less than 2 disc diameters with DO (less still in the presence of significant myopia)

High quality stereoscopic image
Portable

Allows the examiner to remain at arm's length from the patient (which is less intimidating for apprehensive patients than the close proximity required for DO)

Does not require the same degree of cooperation on the part of the patient as do both SBIO and DO. Children tend to be attracted to the light source which for HBIO provides a view of the entire posterior pole, whereas with DO, the tendency for a young patient to fixate the light often results in a good view of the fovea and little else!

Better fundus view through media opacities than with SBIO and especially compared with DO

Either magnification or field of view can be prioritised by varying the choice of condensing lens

Can be used in conjunction with scleral indentation to perform a dynamic examination of the extreme retinal periphery.

Collectively, points 1 to 5 above dictate that HBIO is well suited to the rapid examination of uncooperative or apprehensive patients such as children, and those with learning difficulties. BIO is also well suited to the examination of those unable to be examined at the

Standard reflex-free system



Small pupil adaptation



Yellow circle - Light entering the eye
Red circles - Light leaving the eye

Figure 3 Gullstrand reflex-free system



The high level of retinal illuminance can be uncomfortable for the patient (this effect can be tempered by using condensing lenses with yellow filters and/or by examining the peripheral retina before examining the posterior pole)

To optimise examination of the peripheral retina, the patient should be in the supine position (although a perfectly adequate screening of the fundus may be achieved in children and wheelchair bound patients in the sitting position)

The technique is generally easier to perform if carried out fairly regularly.

The technique

Preparing the patient

Explain the technique to the patient/parent/carer and the reason for carrying it out (including the need for, and side effects of, mydriatic eye drops if these are to be used)

If mydriasis is indicated, steps should be taken to determine the likelihood of precipitating acute angle closure, and a suitable agent(s) instilled (see 'Note on the use of mydriasis before HBIO in adult patients' below)

Visualisation of the peripheral retina is easier, and the technique physically more comfortable for the examiner, if the patient is in the supine position at roughly the level of the examiner's hip. Ideally the examiner should be able to stand both on the right and left and sides of the supine patient as well as immediately behind their head

The room lights should be dimmed allowing reasonable image brightness with minimal light intensity

The patient should remove any spectacles.

Preparing the instrument

Place the instrument over your



Figure 4 A selection of condensing lenses (Image courtesy of J Kanski, Clinical Ophthalmology, 4th edition, Butterworth-Heinemann)



Figure 5 HBIO technique

head positioning the illumination/observation system centrally at the front

Adjust the knob at the top of the instrument to set the forehead band at the correct height relative to your eyes

Adjust the knob at the rear of the instrument such that the band is 'snug' but not excessively tight

Adjust the tilt of the observation system relative to the headband such that your line of sight is perpendicular to the back surface of the eyepieces. The eyepieces should be positioned as close as possible to your eyes/spectacles

Hold your thumb out in front of you at around 50cm in the centre of your field of view. Switch on the illumination, and direct the beam at your thumb (horizontal adjustment is likely to require twisting the headband to the left or right; most instruments have the facility to adjust the vertical direction of the light). Adjust the PD of either eye such that your illuminated thumb is central in the field of view for either eye

Adjust the illumination and aperture size to the required level (erring on the dim side initially – the brightness may be increased later once the patient has adapted)

Hold the condensing lens with the

more convex side facing the examiner. Some manufacturers highlight the side of the lens which should face the patient with a silver or white band (by convention – the bottom of lettering stamped around the edge of the lens also indicates the side which should face the patient).

Examination technique (Figure 5)

The patient should be asked to look straight up at the ceiling (if supine), or over your shoulder if seated

Position your head such that the light source is centred on the patients pupil. Providing the ocular media are clear, you should observe the orange fundus reflex in the pupil

Grasp the lens with your index finger and thumb. Use one or more of your spare fingers of that hand to brace against the patient's forehead to steady the lens. Generally, when examining a patient in the supine position, the lens is held in the right hand when standing on the patient's right side and the left hand when standing on their left. Practising this approach from the outset reaps rewards when attempting scleral indentation, which is easier to learn if the examiner is happy holding the lens in either hand. It is possible to use the spare fingers of the hand holding the



lens to manipulate one of the patient's eyelids to enhance the fundus view. The other hand may be used to manipulate the other eyelid

Position the condensing lens relatively close (2-3cm) to the patient's eye and centred on the patient's pupil. Move the lens slowly away from the patient's eye, keeping the pupil centred in the lens and your spare finger(s) in contact with the forehead. The red reflex will grow to fill the lens and fundus detail will become visible

It is preferable to examine the fundus in a systematic fashion. Most examiners will begin examining the right eye by asking the patient to look to the 12 o'clock position (relative to their head) such that the examiner can view the patient's superior retina from the 6 o'clock position (ie opposite to the patient's direction of gaze). Typically, the extreme periphery is examined first, working toward the equator along that 12 o'clock meridian. The patient is then asked to look halfway between the 12 and 3 o'clock positions, and the examiner moves round to view from between the 6 and 9 o'clock positions. Again the examiner works from the extreme periphery to the equator. Having examined the entire retina from equator to ora in each quadrant, the examination is completed by examining the posterior pole.

Tips

If part of the fundus image is lost, remove the lens to check that the illumination is still centred on the pupil and then repeat step 4 above.

Reflections obscuring the fundus view may be displaced by tilting the condensing lens

Do not be tempted to move closer to the patient. Although moving closer will increase magnification and image brightness, it may disturb binocularity and hence compromise the fundus view

While experienced examiners may choose to assess the peripheral retina prior to the posterior to allow the patient to adapt to the high level of illuminance, it may suit novices to seek to view the posterior pole first

When seeking to sweep their view across the retina (for example from the extreme periphery to the equator) it is vital to maintain a direct line between the observation system, the centre of the condensing lens and the patient's pupil. This is sometimes referred to as the 'common axis principle' (Figure 6)

Remember that although the fundus image is laterally and vertically inverted, you must still direct the patient's gaze

MULTIPLE-CHOICE QUESTIONS – take part at opticianonline.net

- 1** Which of the following statements about the HBIO is true?
- A An image is formed between the condensing lens and the eye of the patient
 - B The silvered ring of the condensing lens needs be held away from the patient
 - C Condensing lenses for use with the HBIO are typically between 15 and 40D
 - D Slit-lamp BIO offers a better retinal view than HBIO through media opacities

- 2** A 20D condensing lens offers how much magnification and field of view?
- A 3 times and 30 degrees
 - B 3 times and 45 degrees
 - C 4 times and 30 degrees
 - D 4 times and 45 degrees

- 3** What is the possible field of view when a 30D lens is used for HBIO?
- A 25 degrees
 - B 45 degrees
 - C 65 degrees
 - D 80 degrees

- 4** To examine the superior fundus, which way should the patient be directed to gaze?
- A Upwards
 - B Downwards
 - C Keep looking straight forward
 - D None of the above

- 5** What is meant by the common axis principle?
- A The patient's gaze, the condensing lens and the practitioner line of view should all coincide along one common axis
 - B The lens should be moved along the same direction as the patient's gaze
 - C The eyepieces of the headset should be focused along the plane of the condensing lens
 - D The eyepieces of the headset should be set to the exact PD of the practitioner

- 6** Which of the following would not be best viewed using HBIO?
- A Patient with learning difficulties and poor cooperation unable to cope with close proximity
 - B Retinoschisis
 - C The fundus of a patient with cataract
 - D Early localised macular elevation due to choroidal neovascularisation

Successful participation in this module counts as one credit towards the GOC CET scheme administered by Vantage and one towards the Association of Optometrists Ireland's scheme. The deadline for responses is August 26 2010



Figure 6 The common axis principle

in the same way as you would during direct ophthalmoscopy. In other words, to view the superior retina, you must still ask the patient to look up, but the most peripheral retina will be seen in the inferior part of the image

To compensate for oblique astigmatism when examining the peripheral retina, tilting the condensing lens in the same direction as the patient's direction of gaze

Avoid holding the lens in two hands as this makes it difficult to progress to using scleral indentation to enhance the examination

Encourage the patient to keep both eyes open to reduce the tendency of Bell's phenomenon.

Further reading

A reading list will be appended to Part 2 published next month.

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