The optical spacer – a simple device which extends the scope of indirect ophthalmoscopy

Donald M I Montgomery

Abstract
A simple device is described which both facilitates and significantly extends the scope of indirect ophthalmoscopy.

The optical spacer is a hollow cylinder which, when coupled to an indirect ophthalmoscopy condensing lens, enables a transparent screen to be positioned at the second principal focus of the lens (Fig 1). When the fundus is observed, the retinal image is formed in the plane of the screen and can thereby be accurately localised in three-dimensional space (Fig 2). Each point on the retina in view forms an image on a corresponding point on the screen, while each point on the screen is in turn imaged upon, and therefore stimulates, its corresponding retinal point which it is seen to overlie. The ease with which stimuli may be introduced into the image plane is the key to several useful applications.

Fixation targets to facilitate indirect ophthalmoscopy
A fixation target in the centre of the screen allows the patient’s eye to be held steady while the posterior pole is examined. If the screen and lens are now rotated about their axis while the eye fixes on a target at the margin of the screen (Fig 3a), the smooth pursuit system is exploited to enable the fundus to be scanned in one continuous movement rather than as a series of disjointed, unpredictable saccades.

Convenient recording of fundus lesions
A lesion in the fundus may be accurately recorded simply by tracing the outline of its image directly on to an acetate sheet placed upon the screen. This record may then be detached and stored in the patient’s case notes. At the next attendance the previously traced outline may be again superimposed upon the lesion. Any change in size will therefore become immediately apparent (Fig 3b).

Assessment of distance visual acuity
If standard Snellen test types are photographed at 6 m with a 35 mm lens and the developed film is then centred on the optical spacer screen located in the focal plane of a +28 dioptre condensing lens, the test types, when viewed through the lens, will subtend the same visual angle as their 6 m equivalents. A convenient, portable visual acuity test is thereby produced (Fig 3c).

Visual field assessment with simultaneous funduscopy
Since each point on the optical spacer screen corresponds to the retinal point imaged at that location, it is possible to map the central visual field under direct vision by 'pointing' at the retinal image with a target pin during ophthalmoscopy while the image is stabilised by a foveal fixation target. By this means functional defects may be readily correlated with the morphological appearance of the retina. The screen may have visual angle and meridional markings to facilitate comparisons with conventional visual field charts (Fig 3d).
Accurate measurement of posterior segment structures and lesions

When the emmetropic eye is examined, because light rays emerging from the eye are parallel, the size of the image formed is independent of the distance of the condensing lens from the patient’s eye. However, in ametropia the emergent rays are either convergent or divergent, and the position and magnification of the image will therefore be influenced by this distance (Fig 4). This effect becomes significant only at degrees of ametropia beyond about 3 dioptres (Fig 5), when it may be overcome by positioning the lens so that the first principal focus coincides with the anterior focus of the eye (as in Fig 2). With this arrangement the image, though still forming at a variable distance from the lens, always subtends the same angle at the principal focal plane. While utilising the foveal fixation target, callipers may be used to measure the stabilised image, enabling the size of the corresponding retinal object to be derived by taking into account the magnification factor of the optical system.

This principle may be employed to advantage in biometry of the optic disc. The relationship between the area of the neuroretinal rim and the optic disc area has previously been shown to alter with the development of glaucoma. Using a +15 dioptre condensing lens with the optical spacer (producing an image magnification of 4·21) and vernier callipers we can make clinical measurements of optic disc and optic cup dimensions, enabling neuroretinal rim areas to be estimated. This simple technique promises to improve clinical interpretation of the optic disc in glaucoma.

Pathological lesions at the posterior pole may be measured by the same method, while measurement in the more peripheral fundus requires in addition that the wide-field retinal magnification factor be taken into account.

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