

# Direct Ophthalmoscopic Indirect Ophthalmoscopy (DIDO) and Estimation Dynamic Distance Direct Ophthalmoscopy (E-DDDO). The Two Novel Uses of Direct Ophthalmoscope!

## Abstract

**Aim:** To describe two novel uses of a direct ophthalmoscope. 1) Direct ophthalmoscopic indirect ophthalmoscopy (DIDO) for the evaluation of the posterior pole of the eye from a distance using a direct ophthalmoscope and 2) estimation dynamic distance direct ophthalmoscopy (E-DDDO) for the objective measurement of accommodation in children.

**Subjects and Methods:** In this prospective observational study, DIDO and E-DDDO were performed on children < 16 years and compared with the current gold standard, the binocular indirect ophthalmoscopy (BIDO) and dynamic retinoscopy (DR), respectively.

**Results:** Of 31 consecutive cases, DIDO identified all 5 patients who had retinal pathology diagnosed by BIDO. Seventeen children, aged  $9.6 \pm 3.1$  years underwent the E-DDDO and DR. The accommodative amplitude with E-DDDO was  $8 \pm 2.3D$ , (range 4-11D) and that with DR was  $8.5 \pm 2.7 D$ , (range 4-14D). One patient with asthenopia & hypo-accommodation was identified on both DR and E-DDDO. The Pearson r for E-DDDO & DR was 0.9. There was no statistical difference between the values obtained on two different techniques (Paired t test – p = 0.6).

**Conclusion:** DIDO and E-DDDO are two valid techniques; DIDO can be used for a rapid screening of the posterior pole of the fundus especially in uncooperative children and E-DDDO can be used to objectively assess the amplitude of accommodation in preverbal children and uncooperative children or adults.

**Keywords:** Direct ophthalmoscopy; Indirect ophthalmoscopy; Accommodation in children; Photorefraction; Dynamic retinoscopy; Dynamic distance direct ophthalmoscopy; Objective evaluation of accommodation; Accommodation in preverbal children; Ophthalmoscopy in children

## Research Article

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**Abbreviations:** DIDO: Direct Ophthalmoscopic Indirect Ophthalmoscopy; BIDO: Binocular Indirect Ophthalmoscopy; E-DDDO: Estimation Dynamic Distance Direct Ophthalmoscopy; DR: Dynamic Retinoscopy

## Introduction

The direct ophthalmoscope, built on the principle of coaxial illumination was introduced by Helmholtz [1] for the evaluation of the posterior pole of the eye. Later the direct ophthalmoscope was used to evaluate the media opacities, afferent pupillary defect and amblyogenic factors [2-4]. In a recent study, the principle of coaxial photorefraction was exploited to use direct ophthalmoscope in the assessment of accommodation in preverbal children [5].

When used in combination with 20D condensing lens, the ophthalmoscope can be used to perform indirect ophthalmoscopy! It is very useful in children who are apprehensive of eye examination especially due to close proximity of the examiner.

Direct ophthalmoscopic indirect ophthalmoscopy (DIDO) can allow the ophthalmologist to visualise the posterior pole of such a child from distance. In this study I have described the technique of DIDO, the optics of DIDO, the performance as well as the advantages and limitations of DIDO. I have also found out that 'retinoscopy rack' and the ophthalmoscope can be used together to ascertain the accommodative amplitude of the eyes which may be very useful in preverbal or uncooperative children! Patients with Down syndrome, cerebral vision impairment, internal ophthalmoplegia, ectopia lentis etc. suffer from poor accommodation and need bifocals for the appropriate management. In this paper, I present the techniques of DIDO and estimation dynamic distance direct ophthalmoscopy (E-DDDO) and compare them with the existing gold standards, binocular indirect ophthalmoscopy (BIO) and Dynamic retinoscopy (DR).

## Materials and Methods

Thirty one consecutive children aged 1-16 years underwent

fundus evaluation of each eye using 20D lens and a direct ophthalmoscope after pupil dilatation followed by the examination of the fundus using a binocular indirect ophthalmoscope. The same examiner who performed the (DIDO) performed the BIO. The examination findings from both the techniques were compared.

Seventeen children (6-16 years) underwent evaluation of the accommodative amplitude of each eye using E-DDDO followed by DR). The difference in the accommodation measured and the Pearson's r (Correlation coefficient) was calculated for the comparison.

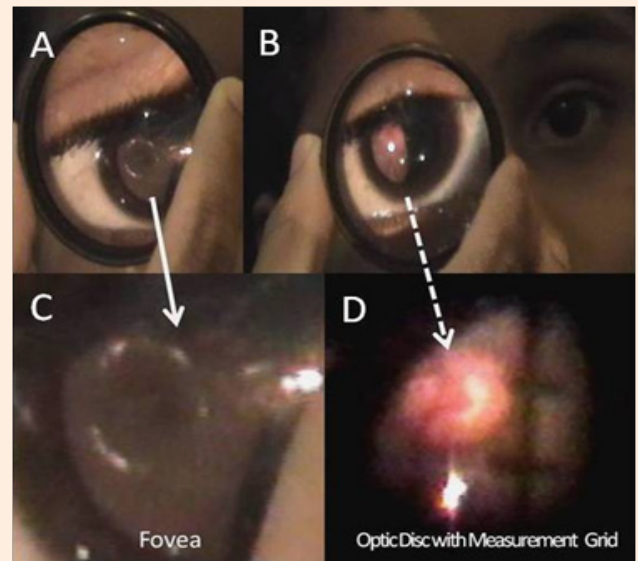
Description of the techniques

### **Direct ophthalmoscopic indirect ophthalmoscopy (DIDO)**

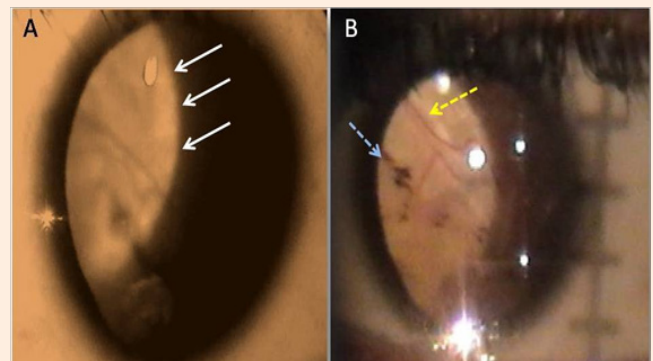
- i. After pupillary dilation, the patient was asked to look straight ahead.
- ii. The direct ophthalmoscope was held in front of the examiner's eye (refractive correction of the examiner was in place) sitting at an arm's length (Figure 1).
- iii. 20D double aspheric condensing lens was placed between the eye of the patient and the ophthalmoscope as shown (Figure 1).
- iv. The distance of the 20D lens was adjusted to visualise and bring the retina in focus (Fig 2A-2D).
- v. To increase the magnification, the examiner moved closer to the condensing lens and moved away for a larger field.
- vi. Different filters, lens apertures and illumination settings can be used as per the need. For the measurement of the lesion, the measurement grid in the ophthalmoscope was used (Figure 2D).
- vii. The patient was asked to look in various directions to view different areas of the retina (Figure 3).



**Figure 1:** Photograph demonstrating the technique of direct ophthalmoscopic indirect ophthalmoscopy. Note the distance and the position of the patient, 20D condensing lens, direct ophthalmoscope and the examiner.



**Figure 2:** Photographs from the direct ophthalmoscope using the DIDO technique demonstrating the details of the fovea (A and C) and the optic disc (B and D).

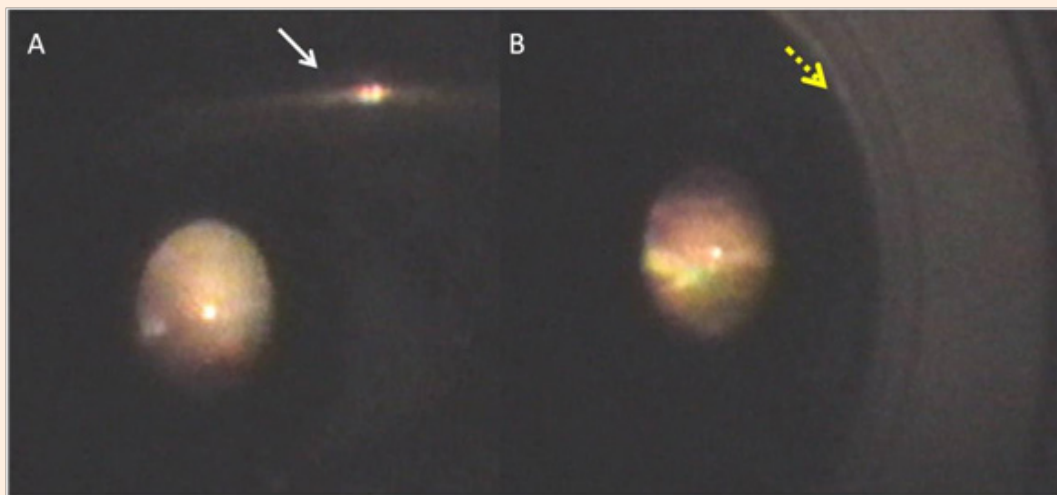


**Figure 3:** Peripheral retina seen through the direct ophthalmoscope showing A) the retino-choroidal coloboma (white arrows) and B) the vasculature and the pigment nests in the intercalary tissue within the colobomatous area.

### **Estimation Dynamic Distance Direct Ophthalmoscopy (E-DDDO)**

- I. The direct ophthalmoscope was held in front of the examiner's eye with the right hand.
- II. The patient was then asked to look at an accommodative target placed at 6 meter while wearing the full refractive correction.
- III. The size of the superior bright crescent was noted (Figure 4A).
- IV. The plus lens from the lens rack were introduced and progressively increased to neutralise the emmetropic crescent (Figure 4B).

- V. The accommodative target was then placed at 40 cm and brought progressively closer at 30cm, 20cm, 10cm and 8cm respectively while the patient fixated and resolved (Figure 5).
- VI. The increasing size of the inferior crescent (myopic crescent) was noted for progressively closer distance which was neutralised with minus lenses from the lens rack until the inferior crescent was no more visible (Figure 6).
- VII. The difference between the power of the lens needed for neutralisation of emmetropic crescent and that for the neutralisation of myopic (accommodative) crescent for the given distance represented the response accommodation of that eye (patient) at the given distance. The dynamic retinoscopy was performed by the previously described method [6].



**Figure 4:** Estimation dynamic distance direct ophthalmoscopy photographs demonstrating A) a superior bright (emmetropic) crescent in a 7 years old child wearing the spectacle (white arrow) and fixating at a distance of 6 meter and B) +0.5D lens (yellow arrow) in front of the same child neutralising the emmetropic crescent.



**Figure 5:** Photograph demonstrating the technique of estimation dynamic distance direct ophthalmoscopy. Note the distance and the position of the patient wearing the spectacle correction, the accommodative target, retinoscopy rack, the direct ophthalmoscope and the examiner.

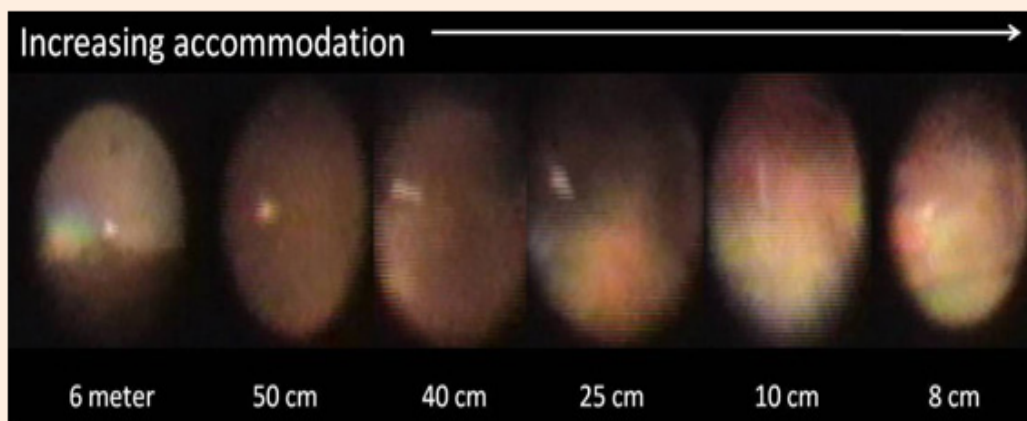


Figure 6: Serial photographs showing the increasing size of the inferior bright crescent with increasing amount of accommodation.

## Results

Of 31 consecutive cases, DIDO identified all 5 patients with pathology on BIDO (coloboma, foveal hypoplasia, primary optic atrophy, Coat's disease (stage 3A) and Stargardt's disease). Of 17 patients who underwent the E-DDDO and DR, the mean age was  $9.6 \pm 3.1$  years. The accommodative amplitude with E-DDDO was  $8 \pm 2.3$  D, (range 4-11D) and that with DR was  $8.5 \pm 2.7$  D, (range 4-14D). One patient with asthenopia & hypo accommodation was identified on both DR and E-DDDO. The Pearson  $r$  for E-DDDO & DR was 0.9 indicating an excellent correlation between the two techniques. There was no statistical difference between the values obtained on two different techniques (Paired  $t$  test -  $p = 0.6$ ). The time taken to perform E-DDDO though not measured in this study seems to be lesser than that with DR. Using an

E-DDDO; accommodation could be measured from both the eyes simultaneously unlike that with DR.

## Discussion

The direct ophthalmoscope produces an upright, or unreversed, image of the fundus with approximately 15 times magnification. For a good view, the ophthalmoscope needs to be used at a very close distance which can be very intimidating in some children and occasionally embracing socially. When used with a condensing lens such as a 20D lens, the image characteristic changes to what is seen with BIO. The image visualised in DIDO is inverted, laterally reversed and real. The optics of the DIDO and BIO (Figure 7 & 8) are similar.

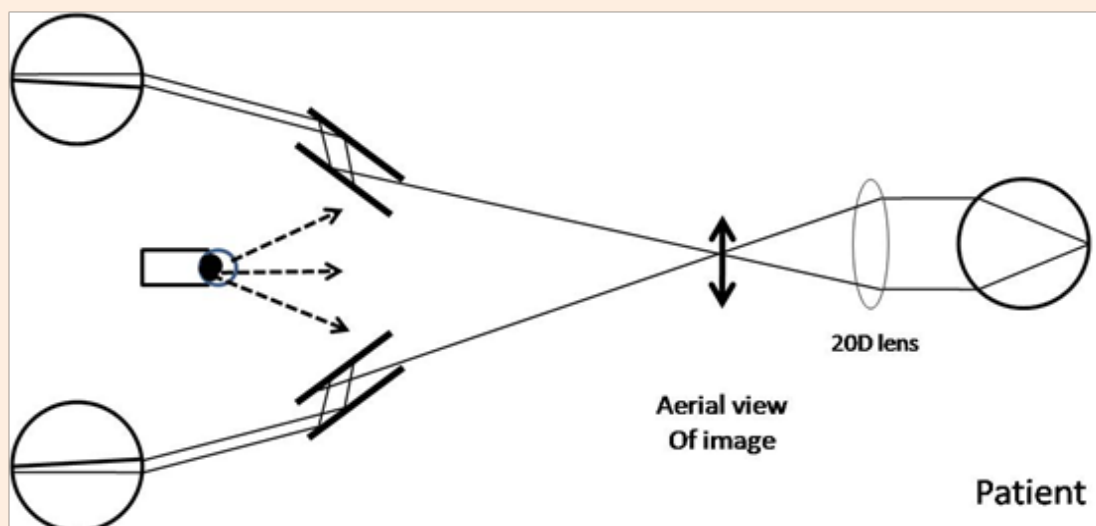


Figure 7: Optics of binocular indirect ophthalmoscopy.

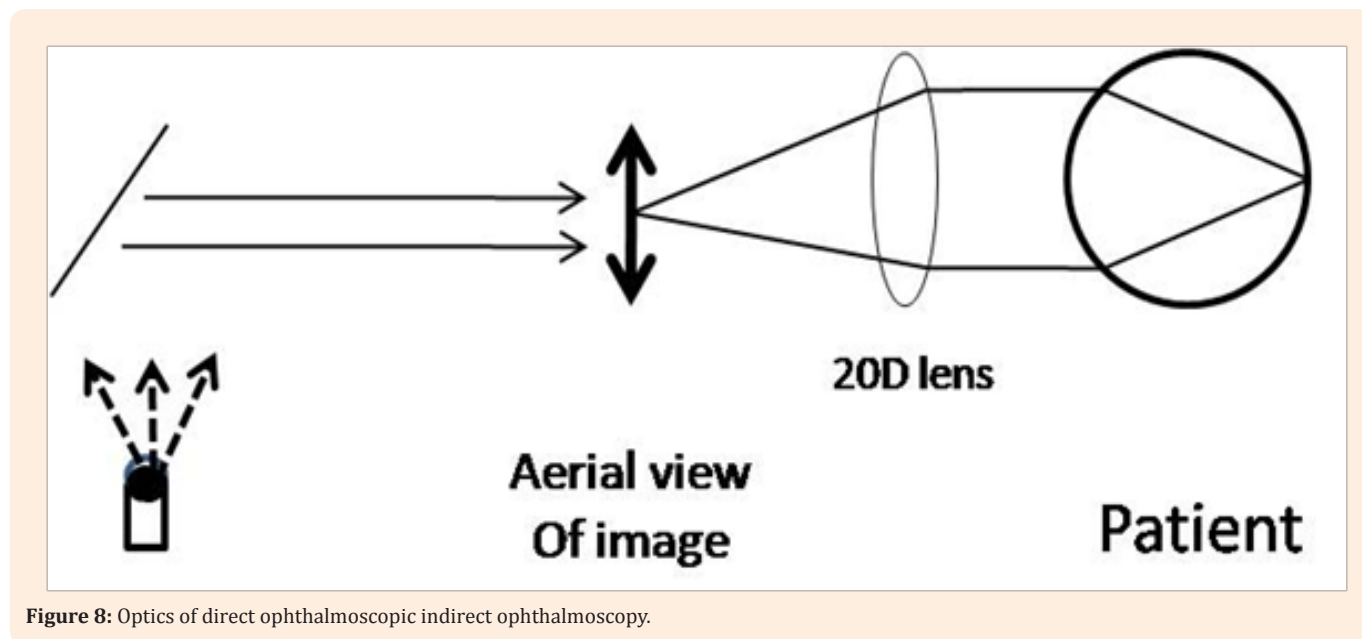


Figure 8: Optics of direct ophthalmoscopic indirect ophthalmoscopy.

The biggest advantage of DIDO over the direct ophthalmoscopy is that DIDO can be performed from an arm length which is less 'threatening' in young children. Another advantage is wider visual field (approximately 5 times larger) as compared to the conventional direct ophthalmoscopy. The optics utilised are similar to that seen in panoptic fundoscope. One more advantage of DIDO is an extremely high portability of the direct ophthalmoscope versus BIO. We do not consider DIDO can replace a BIO as lack of binocularity and inability to visualise the equator or periphery with DIDO would be unacceptable consequences and can result in missing important fundus abnormalities in clinical practice. Also, the light reflexes from the coaxial illumination of a direct ophthalmoscope results in inferior image quality with DIDO as compared to BIO and prevents it to be performed in undilated pupils.

I feel the most important use of the DIDO is for a quick screening of the posterior pole in children who are uncooperative for BIO and direct ophthalmoscopy, to assess the extra foveal fixation and to assess the relative position of the fovea in comparison of the optic disc in evaluation of ocular torsion in cyclovertical squint. The use of direct ophthalmoscope and the optics of dynamic distance direct ophthalmoscopy in the assessment of accommodation were recently described by Kothari et al. [5]. They did not attempt to quantify the accommodation in that paper. Nevertheless, it is important to quantify the accommodative deficits in children with accommodation failure for the appropriate optical correction as well as monitor the deterioration or improvement in the condition.

In the present study on a small group of normal subjects, I found E-DDDO was as good a technique as DR in the objective evaluation of accommodative amplitude in children. An important limitation of E-DDDO was inability to separately evaluate different meridian which is possible with DR. However, variable accommodative response in different meridia of an eye is rare and suspected to

occur in the ciliary body/zonule coloboma. The E-DDDO was advantageous over DR as it was faster and could be done on both eyes to rule out aniso accommodation (different accommodative responses in the eyes of a patient). I found the E-DDDO was easier to learn and perform as compared to DR among the ophthalmic residents and fellows. However, further studies are needed to evaluate E-DDDO in patients with accommodative defects and intra test as well as intertester reliability with adequate sample size.

### Summary

This manuscript reports two new uses of direct ophthalmoscope. Both the diagnostic techniques are valid and have relevant place in the diagnostic armamentarium of the ophthalmologists. Further studies are needed to evaluate both the techniques in different clinical settings with different diseases of variable magnitude.

### Acknowledgement

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