Utility of multicolor optic disc photography in evaluation of glaucomatous optic disc in myopic eyes: A novel approach

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Interpretation of optic disc cupping and neuroretinal rim is challenging in myopic eyes because of large, shallow, and tilted disc, myopic crescent, and macular degeneration. Color and red-free optic disc photographs do not reveal the cup/disc ratio often in myopic eyes. We report characteristics of multicolor optic disc photography in three myopic eyes. All eyes underwent multicolor imaging Spectralis SDOCT system (Heidelberg Engineering, Germany). Owing to use of three laser lights in a confocal design, multicolor optic disc photography was able to delineate the neuroretinal rim and optic cup more clearly than color and red-free optic disc photographs.

Key words: Glaucoma, multicolor imaging, myopia, optic disc

Glaucoma is a progressive optic neuropathy in which high intraocular pressure or compromised optic nerve head blood flow leads to loss of retinal nerve fiber layer. This loss is clinically evident as cupping or focal loss of neuroretinal rim.[1] A 20° color optic disc photograph (cODP) or 30° red-free photograph centered over disc are few of the main imaging modalities to diagnose, record, and follow patients with glaucoma.[2] Myopia is considered a risk factor for glaucoma.[3] Owing to flat optic disc, shallow cup, temporal crescent, and myopic degeneration, interpretation of disc cupping on cODP is challenging in myopic eyes.[4] Multicolor imaging (MCI) is a new imaging modality available on Heidelberg Spectralis SDOCT system.[5] It has been recently used for imaging both retinal and optic nerve disorders.[6-9] We report here the utility of multicolor optic disc photograph (mcODP) in documenting glaucomatous changes in myopic eyes. Fundus camera FF450 Plus (Carl Zeiss Meditec) was used to obtain 20° cODP and 30° red-free optic disc photographs for comparison, whereas MCI was performed using Spectralis SDOCT system.

Access this article online

Quick Response Code:

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_1385_18

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Manuscript received: 19.08.18; Revision accepted: 18.11.18

Case Reports

Case 1

A 45-year-old man presented with best corrected visual acuity (BCVA) of 6/36, N10 with −20 diopter in the right eye and 6/24, N8 with −18 diopter in the left eye. Intraocular pressure was 14 mmHg in both eyes. Fundus revealed tessellated appearance with peripapillary atrophy and vertical cup/disc ratio of 0.8:1 in the right and 0.5:1 in the left eye.

cODP of right eye [Fig. 1a] showed shallow optic disc. The cup was not well delineated. Red-free image [Fig. 1b] showed large optic disc. mcODP of right eye [Fig. 1c] showed neuroretinal rim as darker margin of the disc along with relatively brighter central cup suggesting a cup/disc ratio of 0.8:1. Infrared reflectance (IR) image also showed neuroretinal rim as darker boundary around the central, relatively bright cup [Fig. 1d]. The cODP and red-free images of the left eye showed large optic disc but did not clearly show the cup [Fig. 2a and b]. mcODP and IR image delineated the cup as bright central region surrounded by darker neuroretinal rim [Fig. 2c and d].

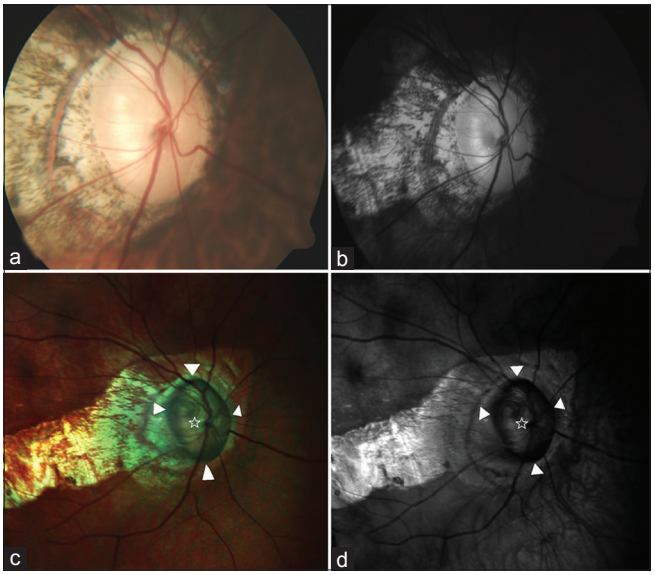

Figure 1: (a) cODP of the right eye shows large optic disc with shallow cup. (b) Red-free photo image shows large disc with shallow cup. Cup/disc ratio is not evident. (c) mcODP delineates the cup as central bright zone (*blank star*) surrounded by darker neuroretinal rim (*arrow heads*). The vertical cup/disc ratio is 0.8. (d) IR image also delineates the cup (*blank star*) and neuroretinal rim (*arrow heads*)

Cite this article as: Basu T, Garg B, Mishra S, Goel S, Roy R, Saurabh K. Utility of multicolor optic disc photography in evaluation of glaucomatous optic disc in myopic eyes: A novel approach. Indian J Ophthalmol 2019;67:412-4.

Case 2

A 52-year-old man presented with BCVA of perception of light alone in the right eye and 6/12, N8 in the left eye. His refractive correction was −4 diopter in the right eye and −3.5 diopter in the left eye.

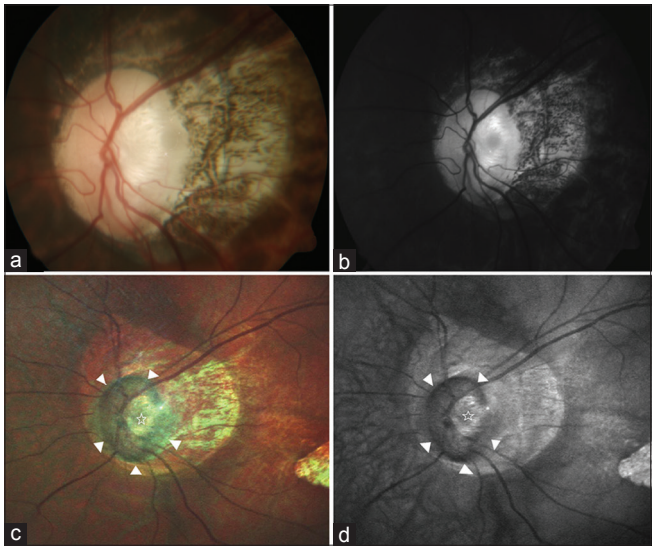

Figure 2: (a) cODP of left eye shows large disc with shallow cup. The vertical cup/disc ratio appears 0.65:1. (b) Red-free image shows similar large disc and shallow cup with apparent vertical cup/disc ratio of 0.65:1. (c) mcODP delineates the central cup as brighter zone (*blank star*) surrounded by dark neuroretinal rim (*arrow heads*). Vertical cup/disc ratio is 0.5. (d) IR image also delineates neuroretinal rim (*arrow heads*) and cup (*blank star*) better than cODP and red-free image. cODP and red-free images tend to overestimate the cup/disc ratio in this eye which was accurately measured by mcODP and IR image

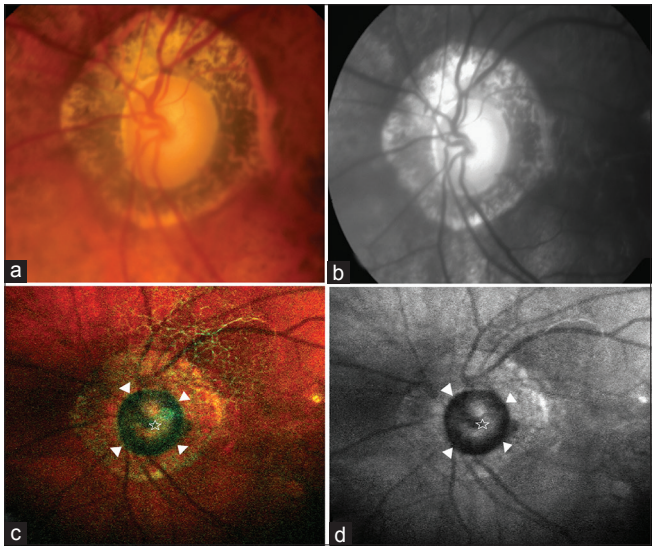

Figure 4: (a) cODP of left eye shows peripapillary atrophy with large optic disc and shallow cup. (b) Red-free photo also shows large optic disc with shallow cup. But vertical cup/disc ratio cannot be reliably measured. (c) mcODP of left eye better delineates cup (*blank arrow*) and neuroretinal rim (*arrow heads*) suggesting a vertical cup/disc ratio of 0.7:1 (d) IR image also better delineates the cup (*blank arrow*) and neuroretinal rim (*arrow heads*)

Intraocular pressure was 28 and 18 mmHg in the right and left eye, respectively. Fundus revealed attached retina with peripapillary atrophy and vertical cup/disc ratio 0.9:1 in the right and 0.7:1 in the left eye.

cODP of the right eye showed large optic disc [Fig. 3a]. Red-free image showed large optic disc but the size of the

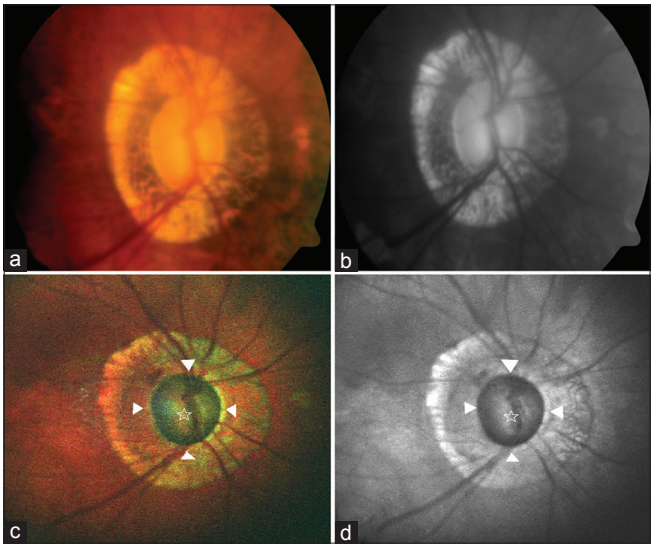

Figure 3: (a) cODP of the right eye shows peripapillary atrophy, large optic disc, and shallow cup. (b) Red-free photograph also shows large disc with shallow cup. Vertical cup/disc ratio is not discernible. (c) mcODP of the right eye shows neuroretinal rim (*arrow heads*) as dark surrounding zone around central bright cup (*blank star*), suggesting a vertical cup/disc ratio of 0.9:1. (d) IR image also shows neuroretinal rim (*arrow heads*) and cup (*blank star*) better than cODP and red-free photo

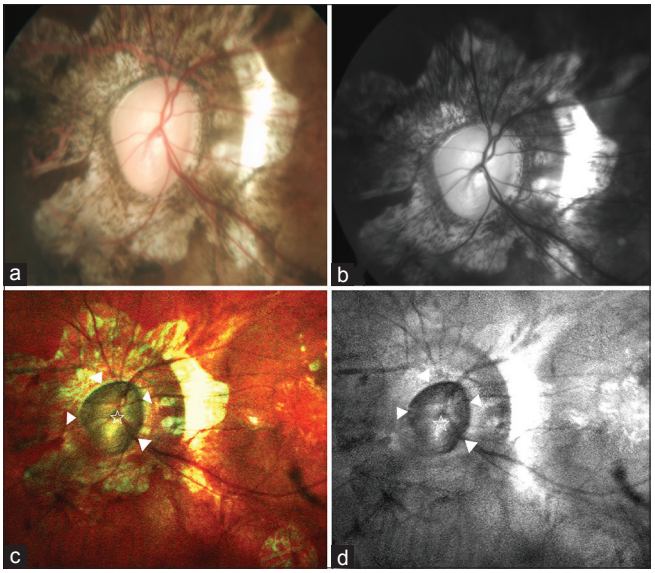

Figure 5: (a) cODP shows myopic large disc with shallow cup with ill-defined margins. (b) Red-free photo also does not delineate the margins of cup and neurosensory rim. (c) mcODP delineates the margins of cup (*blank star*) and the neurosensory rim (*arrow heads*) better than cODP and red-free photo. (d) IR photo also shows neurosensory rim (*arrow heads*) and cup (*blank star*). Both mcODP and IR photo suggest a vertical cup/disc ratio of 0.9:1

cup was not discernible [Fig. 3b]. mcODP showed large optic disc with darker circumferential neuroretinal rim and relatively bright central cup suggesting vertical cup/disc ratio of 0.9:1 [Fig. 3c]. IR image also revealed the neuroretinal rim and cup separately [Fig. 3d]. The cODP and red-free image of the left eye revealed large optic disc [Fig. 4a and b]. Delineation of cup was possible on red-free image [Fig. 4b]. mcODP and IR image showed darker neuroretinal rim around central cup which appeared bright [Fig. 4c and d].

Case 3

A 45-year-old female patient presented with BCVA of 6/12, N8 in her left eye. Her right eye was phthisical. The refractive correction in the left eye was −6.5 diopter. Intraocular pressure was 26 mmHg. Fundus revealed tessellated retina with peripaillary atrophy, large optic disc, and vertical cup/disc ratio of 0.9:1.

The cODP of the left eye showed large and shallow optic disc and the cup was not clearly discernible [Fig. 5a]. Red-free image also showed large optic disc. Neuroretinal rim was seen faintly [Fig. 5b]. mcODP and IR images showed the vertical cup/disc ratio as 0.9:1 by showing neuroretinal rim and cup separately [Fig. 5c and d].

Discussion

Diagnosing a glaucomatous disc in myopic eyes is a challenging task to ophthalmic practitioners.[1,2] MCI has many advantages over color fundus photography. It is less photophobic to the patient, can be used in undilated pupil, allows imaging through lens haze, and can be combined with SD-OCT in a single device to allow simultaneous fundus and cross-sectional imaging. MCI uses blue (488 nm), green (515 nm), and infrared (820 nm) lasers to detect features at different levels of retina.[6] Blue channel shows superficial retinal layers. Green channel is responsible for imaging inner retinal features. Infrared channel images outer retina and choroid. The composite of these three reflectance images is multicolor image. As MCI is based on confocal microscopy and uses different laser lights of different wavelengths which can penetrate up to certain layers of retina and choroid, it provides topographic evidence of tissue, a feature which is not permissible with conventional white light color photography.[5-9] MCI technology has been used to image superficial features such as epiretinal membrane to deeper lesions such as retinal pigment epithelitis, optic disc pit, and optic disc swelling.[5-9] When cup/disc ratio was not discernible on cODP or red-free image, mcODP and IR were able to discern the same, corroborating with the clinical examination. Because the cup is present at a deeper level and farther from the laser source compared to superficial neuroretinal rim, it is imaged predominantly by infrared channel and rendered brighter by MCI technology. Neuroretinal rim being relatively superficial is imaged predominantly by green and blue channels and is rendered as darker allowing measurement of cup/disc ratio. Thus, multicolor composite image along with its individual color channels was effective in characterizing myopic disc in the current series and can help clinicians in decision-making, particularly where glaucomatous disc damage is suspected in a high myopic eye. Spectralis image reproducibility is restricted beyond − 14 diopter, which may be a limitation of this imaging modality.

Conclusion

In this current case series, we have attempted to highlight the superiority of MCI for imaging glaucomatous disc damage in myopic discs. Although a study with larger number of participants will be needed to buttress our initial findings, our report still provides initial insight into an enigma called myopic optic disc through a novel MCI modality.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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