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Original Research Article

# Comparison of optic nerve head analysis using optical coherence tomography and slit-lamp biomicroscopy

**Ranjiv R[1], Rishi Sharma[1,*]**

[1]*Military Hospital, Secunderabad, Telangana, India*

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ABSTRACT

**Background**: Optic nerve head examination is the hallmark of glaucoma diagnosis. The difficulties in clinical assessment of the optic nerve head relate to its inherent subjectivity and large diversity in the appearance of discs.
In this study the optic nerve head assessment using optical coherence tomography and slit-lamp biomicroscopy were compared to study the significance of difference in the cup-to-disc ratio as calculated by the 2 methods.
**Settings and Design**: The material of the study were patients attending the outpatient department of a Tertiary hospital.
**Materials and Methods**: A prospective observational study was conducted. Group I consisted of 50 patients with primary open angle glaucoma and Group II consisted of 50 non-glaucomatous patients. SBM and OCT were done to assess the average cup to disc ratio (CDR).
**Statistical analysis used**: Average CDR was calculated by the 2 methods and was compared by Pearson correlation in which the correlation value of +1 is a total positive correlation, 0 is no correlation and −1 is a negative correlation. The statistical software SPSS 15.0 was used.
**Results**: The correlation values for the right eye in the control group was 0.84 and in the case group was 0.89. The correlation values for the left eye in the control group was 0.68 and in the case group was 0.90.
**Conclusions**: The study found the OCT findings closely mirror the clinical findings especially in cases of glaucoma.
**Key Messages:** ONH analysis is the hallmark of Glaucoma Diagnosis. OCT is user independent and reliable but is a tedious process and not advisable in a busy practice for ONH assessment. Clinical examination with slit lamp biomicroscopy closely mirrors the findings of OCT and is the cornerstone for the assessment of ONH in OPD practice.



## 1. Introduction

Glaucoma is a family of chronic, progressive and potentially blinding optic neuropathies characterized by distinctive morphological (or 'structural') changes of the optic nerve head (ONH) and retinal nerve fibre layer (RNFL) associated with visual field changes and loss of visual function.[1] According to a World Health Organization survey conducted in 2004, it is the second leading cause blindness in the world.[2] Glaucoma is typically characterized by a triad of raised intraocular pressure (IOP), visual field defects and optic nerve head (ONH) changes. ONH examination is the most important step in the assessment of a patient, as it serves not only as a guide to suspicion of glaucoma but also helps in monitoring patients with established glaucoma.[3] This is because damage to the

* *Corresponding author*.
*E-mail address*: rs19april81@gmail.com (R. Sharma).

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retinal ganglion cells is most easily identified over the optic nerve head.[4] The cup to disc ratio (CDR) indicates the diameter of the disc expressed as a fraction of the diameter of the disc. It has been shown that a good predictor of glaucoma is the CDR of the ONH.[5,6] Hence, accurate assessment of the average CDR and vertical CDR is the hallmark of glaucoma diagnosis. Slit lamp biomicroscopy (SBM) done using +90D lenses is presently the most common clinical tool employed for analysis of the optic nerve head. Among the newer modalities optical coherence tomography (OCT) is more commonly being used.[7] Although clinical assessment using SBM with +90D lens is considered to be the standard modality, there is no modality that is without inherent disadvantages. Hence, there is a need to compare different methods of assessing ONH and examine the effects of measurement variability.[8] The objectives of the study were to assess the optic nerve head using optical coherence tomography and slitlamp biomicroscopy and to compare the findings and to study the significance of the difference in the CDR as calculated by the 2 methods.

## 2. Materials and Methods

A prospective observational study was carried out. The material of the study was patients attending the outpatient department of a tertiary hospital. Patients were examined in two groups. Group I consisted of 50 patients with established cases of Primary open angle glaucoma (POAG) aged between 20 yrs to 70 yrs. This Case group consisted of Individuals who had features of open angles in gonioscopy, characteristic field changes and optic nerve head changes were included in the study. Individual with refractive errors beyond –12 and +12 dioptres of sphere or between –12 and +12 dioptres of cylinder, other ocular diseases, optic disc anomalies like tilted disc, optic disc coloboma etc and individuals who had undergone any previous ocular surgery except uncomplicated cataract surgery were excluded. Group II consisted of 50 non-glaucoma patients, age and gender- matched, who are willing to give consent, and who had come for routine ophthalmological check-ups. This group was termed as the control group. Both eyes of the case group and the control group were studied.

## 3. Method of data collection

A complete systemic and ocular history was taken. This was followed by a detailed ophthalmic evaluation. The intraocular pressure was measured using Goldmann applanation tonometry. Indirect gonioscopy was performed using Goldmann 3-mirror gonioscope to rule out closed angles and occludable angles. Visual field analysis was done using standard automated static perimetry, threshold 30-2 with Goldmann size III target, a 31.4 asb, white background and full threshold strategy. All the information was recorded in a set proforma. Slitlamp biomicroscopy and optical coherence tomography were done for all patients. Slit lamp biomicroscopy was done using a +90 D lens and the average cup disc ratios were assessed by an experienced examiner. Evaluation of OCT was done using the Fast Optic Disc Protocol on the Zeiss Stratus OCT Model. The optic disc cube 200 × 200 protocol was used to acquire RNFL thickness measurements and measurements of disc area and CDR. The parapapillary RNFL thickness measurements were calculated from a 3.46-mm-diameter circular scan (10.87-mm length) automatically placed around the optic disc. The average RNFL thickness corresponds to the 360° measure automatically calculated by the OCT software (software version 6.0; Carl Zeiss Meditec, Inc.).

### *3.1. Statistical methods*

Pearson correlation between study variables was performed to find the degree of relationship. The statistical software namely SAS 9.2 and SPSS 20.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

| Classification of correlation co-efficient (r) | |
|---|---|
| Up to 0.1 | Trivial correlation |
| 0.1-0.5 | Small to moderate correlation |
| 0.5-0.9 | Large correlation |
| 0.9- 1.0 | Nearly perfect correlation |
| 1 | Perfect correlation |

## 4. Results

The study was conducted in 200 eyes of 100 patients and a comparative case-control study was done.

**Table 1:** Age distribution of patients studied

| Age in years | Controls | | Cases | |
|---|---|---|---|---|
| | No | % | No | % |
| <40 | 2 | 4.0 | 1 | 2.0 |
| 40-50 | 9 | 18.0 | 7 | 14.0 |
| 51-60 | 11 | 22.0 | 14 | 28.0 |
| 61-70 | 16 | 32.0 | 14 | 28.0 |
| 71-80 | 12 | 24.0 | 12 | 24.0 |
| >80 | 0 | 0.0 | 1 | 2.0 |
| Total | 50 | 100.0 | 50 | 100.0 |
| Mean ± SD | 60.48±12.27 | | 61.04±11.61 | |

Samples are age matched with P = 0.815 as per the Student t test. The mean age was 60.48±12.27 ranging

## 5. Discussion

The vertical cup/disc ratio (CDR) has long been used in the assessment of the glaucoma suspect.[9] Cup size is

**Table 2:** CDR values calculated using optical coherence tomography

| Cup to Disc Ratio | Slit Lamp Biomicroscopy | | Optical Coherence Tomography | |
|---|---|---|---|---|
| | Controls | Cases | Controls | Cases |
| Right eye | 0.39±0.12 | 0.68±0.11 | 0.41±0.13 | 0.75±0.10 |
| Left eye | 0.40±0.12 | 0.66±0.11 | 0.43±0.13 | 0.74±0.12 |

**Table 3:** Pearson correlation of study outcome between the methods optical coherence tomography and slit lamp biomicroscopy

| OCT VS SBM | Controls (r value) | Cases (r value) |
|---|---|---|
| Right eye | 0.84 | 0.89 |
| Left eye | 0.68 | 0.90 |

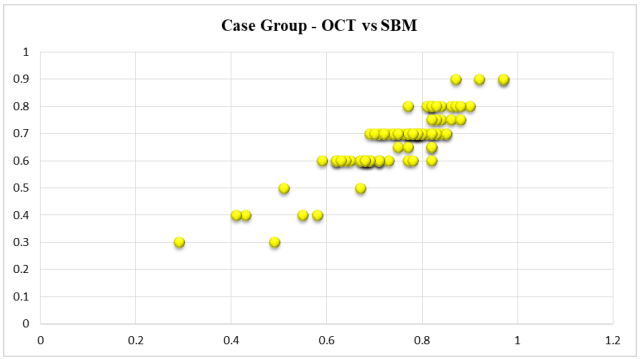


**Fig. 1:** Scatter plot analysis of CDR in cases of glaucoma comparing OCT and SBM. (r values closer to +1 indicate good correlation between two diagnostic techniques)

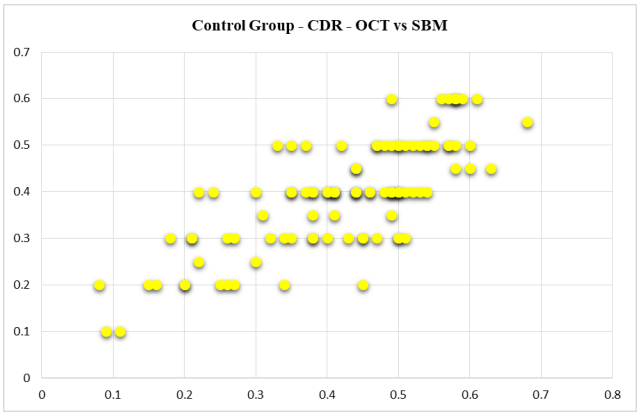


**Fig. 2:** Scatter plot analysis of CDR in controls comparing OCT to SBM

related physiologically to disc size and pathologically to glaucomatous damage. Disc size can be measured at the slit lamp as the vertical disc diameter (DD). Hrynchak P et al in a study compared CDR measurement in normal subjects using OCT and SBM.[9] Similar studies were conducted by Prof. [Dr.] Meenakshi Dhar et al. where they compared the results of optic disc analysis using stereoscopic biomicroscopy, stereo fundus photography and optical coherence tomography.[10] A study done by Betz, P et al. wherein the Stereoscopic and photogrammetric imaging of the disc cup in open-angle glaucoma revealed several morphological changes. The ovalisation of the cup, upwards, downwards or on the temporal side, appears early and can be detected at the onset of the disease, even in the absence of visual field defects.[11] It is possible to quantify the areas of the optic disc, neuro-retinal rim, and optic cup by computer aided analysis of optic disc photographs or by more recently available imaging techniques, such as scanning laser ophthalmoscopy, video-ophthalmography,[12,13] and simultaneous stereo optic disc photography with digital photogrammetry.[14,15]

This comparative case control study was conducted in 200 eyes of both glaucomatous and non-glaucomatous eyes. The mean age of Group I (Cases) individuals was 61.04±11.61 years and the mean age of Group II (Controls) was 60.48±12.27 years.

The correlation values for the right eye in control group was 0.84 and in case group was 0.89. The correlation values for the left eye in control group was 0.68 and in case group was 0.90 for CDR. Scatter graphs were plotted using the data. In this study that both the tests correlated well with each other and a better correlation was seen among cases than in controls.

## 6. Conclusion

ONH analysis is the hallmark for Glaucoma Diagnosis. OCT is user independent and reliable but is a tedious process and not advisable in busy practice for ONH assessment. Clinical assessment of ONH using +90 D lens correlates well with OCT findings, we recommend that Clinical examination be always preferred to assess the ONH in an OPD setting and OCT be used as a tool to record findings in select cases.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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## Author biography


**Ranjiv R,** Ophthalmologist

**Rishi Sharma,** Ophthalmologist https://orcid.org/0000-0003-3932-7337


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