A STUDY TO CORRELATE OPTIC CUP/DISC RATIO WITH VISUAL FIELD DEFECTS IN PRIMARY OPEN ANGLE GLAUCOMA

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Abstract: **Background & Objectives**: This study was undertaken to assess the correlation between Vertical cup/disc (C/D) ratio found on ophthalmologic examination in Primary open angle glaucoma and loss variance which indicates local heterogenicity of visual field defect. Severity of scotomas was also assessed. **Material & Methods**: After comprehensive eye examination and glaucoma evaluation, 27 subjects (total 47 eyes) diagnosed with primary open angle glaucoma underwent visual field analyses on Octopus 900 computerised perimetry analyser. Data was tabulated and statistical tests were applied. **Results**: We found a statistically significant correlation between C/D ratio and loss variance at $p<0.05$. Also severity of scotomas increased in advanced cases with a higher C/D ratio. **Interpretation**: Patients with open angle glaucoma show progressive cupping of optic disc with more propensity of retinal fiber damage giving rise to worsening visual field defects. Regular evaluation with automated perimetry is of utmost importance and can help in better management of glaucoma.

Key Words: Cup/Disc Ratio, Octopus 900 Perimeter analyser, Primary open angle glaucoma, scotomas.

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Introduction:

Primary open angle glaucoma is an important cause of irreversible blindness in India and world over[1]. Risk factors include age more than 40 years, heredity, Diabetes mellitus and myopia[2]. It is a silent disease in which initially the patient does not have any symptoms and the signs need to be carefully looked for, otherwise the disease may not be diagnosed[1]. In early stages when the retinal nerve fiber damage is still less than 40%, no notable changes are found on a white on white visual field analysis[3]. By the time the person has obvious defects in fields, usually significant retinal nerve fiber damage has already occurred[4]. Of the several changes on Fundus examination like peripapillary atrophy, retinal nerve fiber layer changes, Neuroretinal rim changes, hemorrhages, cup-disc changes; Vertical cup-to-disc ratio (CDR) is an important parameter determined at fundus examination and commonly used in identifying elongation of optic cup and loss of neuro-retinal rim[5,6]. Additionally it is a quantitative finding that the physician can monitor on follow up visits as well. Several studies have been done which correlate the changes in cup/disc ratio and or other changes at fundus with visual field defects on perimetry[7,8]. Visual field analysis (using static and kinetic perimetry singly or in combination) allows complex analysis to be made of the patient's visual field with several values pertaining to field defects. For our study, we used values of loss variance (obtained with Octopus 900 automated perimetry analyzer) which calculates the local heterogenecity of a visual field defect i.e quantitatively how severe the defect is compared to the generalized depression of the visual field caused by other reasons like refractive errors, media opacities, miosis etc. Our study is the first of its kind as that we have studied on Octopus 900 automated perimetry analyzer, while earlier studies have used perimetry results done on Goldmann and Humphrey's automated analyser[7,8].

Aims & Objectives: In our current study we have aimed

1.) To analyse the correlation between Vertical cup/disc ratio with the loss variance.

2.) To study the proportion and pattern of scotomas in mild, moderate and severe groups of glaucoma damage.

Material and Methods:

Patients aged between 18-65 years and diagnosed as having primary open angle glaucoma by comprehensive eye examination and Glaucoma evaluation underwent a Visual field study on Octopus 900 (HAAG STREIT) automated perimetry analyzer at a tertiary referral centre. All the subjects diagnosed as having Primary Open Angle Glaucoma had open angles >/= Gr III according to Shaefer's classification on gonioscopy. Vertical cup/disc ratio obtained by slit-lamp biomicroscopic examination using 90D lens. All the patients underwent a G-TOP (Glaucoma Tendency Oriented Perimetry) strategy white on white field testing. Patients of angle closure, secondary glaucoma, those with history of antiglaucoma surgery (peripheral iridotomy, iridectomy, filtration surgery etc) or any other ocular surgery, ocular trauma with significant impairment of visual acuity or uncorrected refraction were excluded. In the final data, again, exclusion was made if the reliability factor (RF) of the visual field test was more than 15%. All ethical aspects were adhered to.

In the final analysis, data from 27 subjects, a total of 47 eyes were included based on the above criteria. Subjects were divided into 3 groups based on the vertical C/D ratio. Patients with CDR </= 0.5, 0.6-0.7 and >/= 0.8 were classified respectively as having mild, moderate and severe glaucoma. Correlation between vertical optic cup/disc ratio and Loss variance was analyzed in all 3 groups. Type and proportion of scotomas in each group was also studied. Table of CD ratio and Loss variance was prepared. Data was anaylsed in EPI_INFO 7.0 and Spearman's correlation coefficient was calculated. The value of R (rho) was 0.38 and the p value was 0.007 which is statistically significant. Data regarding type of scotomas and proportion of scotomas in each group was also studied.

Result: We found that between the 3 groups, as the Cup/Disc ratio increased, the Loss Variance increased (Spearman's correlation coefficient, R = 0.38, p value = 0.007). Also the proportion of scotomas increased with increase in CD ratio. In mild glaucoma, with suspicious discs there were no significant/characteristic field defects nor increase in Loss variance. The results are summarized in figure 1,2 and 3 and in table-1.

Figure 1: Correlation of loss variance with vertical C/D ratio.

X axis represent CD ratio while Y axis shows loss variance values. With lower CD ratios retinal nerve fiber layer damage is less and hence field defects are not obvious giving rise to lower values of loss variance while with higher CD ratios the field defects worsen. The line passing through the scatter shows this linearity of the relationship

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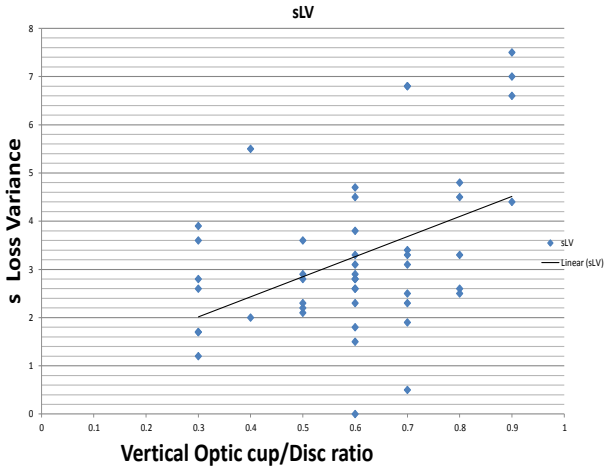
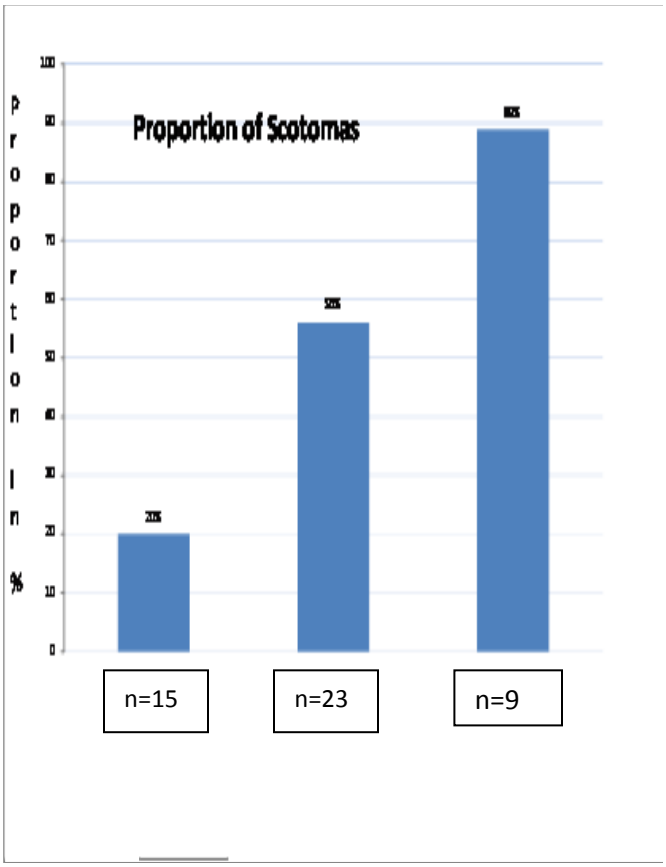


Figure 2: Proportion of scotomas in mild, moderate and severe cases.

Proportion of scotomas increased from 20% to 56% to 89% respectively from mild to moderate to severe Glacuoma as the CD ratio progressed.



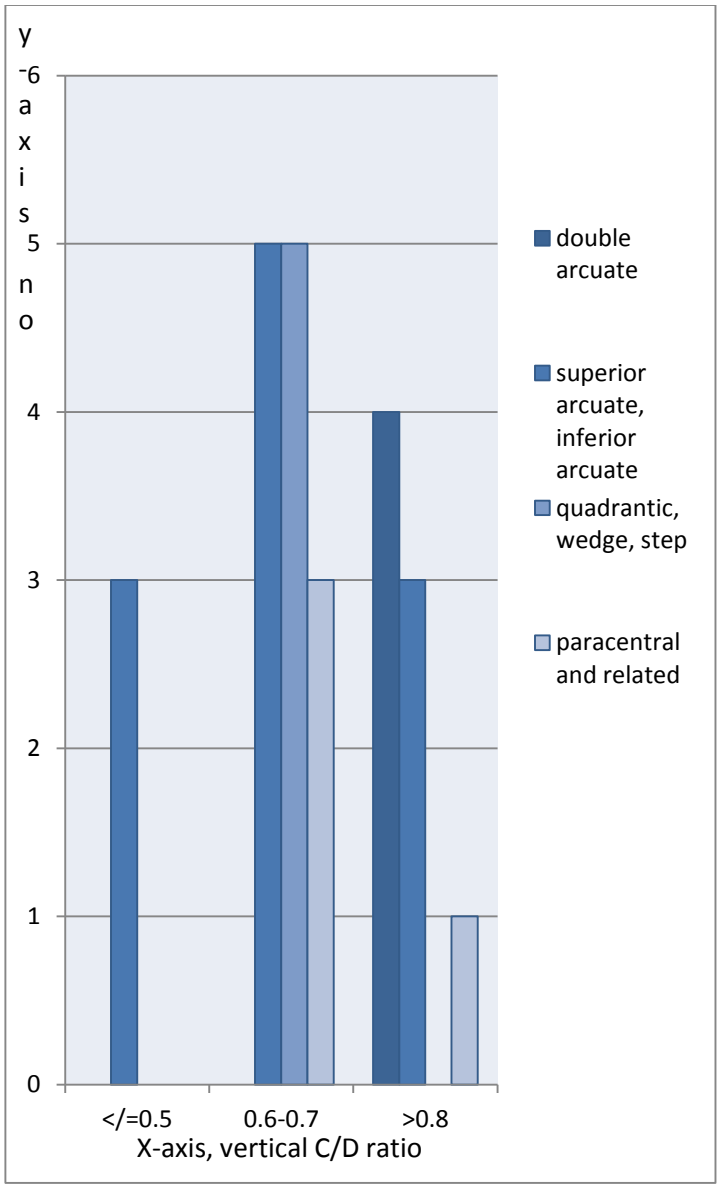


Figure 3: Severity of scotomas increased with increasing C/D ratio.

Patients with CDR<0.5 had a propensity towards either superior or inferior arcuate scotmas, with increase in CDR to 0.6-0.7,qudrantic, wedge and paracentral scotomas were also found. In severe cases more no. of patients had a double arcuate scotomas which could be due to combining of scotomas in different regions of visual field.

Table 1: Pattern of scotomas in each group.

Sr.	C/D ratio	No. of eyes	Pattern of scotomas	Total no. and proportion
1.	</= 0.5	15	2 inferior arcuate, 1 superior arcuate	3 abnormal→3/15→20%
2.	0.6-0.7	23	2 paracentral, 5 developing inferior arcuate, 2 nasal wedge, 1 inferior nasal quadrantic, 1 superior temporal wedge, 1 developing central, 1 inferior temporal wedge	13 abnormal→13/23→56%
3.	>/=0.8	9	4 double arcuate, 3 inferior arcuate, 1 paracentral	8 abnormal→8/9→89%

Discussion: In our study, patients with primary open angle glaucoma were found to have visual field defects which correlated with their cup/disc ratio on a routine fundus examination. In a similar study, other lesions like peripapillary atrophy, retinal nerve fibre layer defect, hemorrhages etc. also routinely seen on fundus examination alongwith ONH(optic nerve head) cupping were compared with visual field defects analysed on a Humphrey's automated visual field analyser[1]. However a quantitative analysis and correlation was not done. Our finding that, as damage progresses, field defects increased and additionally scotomas became more severe, correlates clinically; as, with severe cup enlargement, there is more damage to retinal nerve fibres. With increase in intra ocular pressure in Primary open angle glaucoma, there is pressure effect on the lamina cribrosa and in severe cases the cup shows excavation with more propensity of damage to retinal nerve fibres[9]. In mild glaucoma, with suspicious discs there were no significant or characteristic field defects nor increase in Loss variance as the damage is too early to be picked up on white on white perimetry. This is consistent with the fact that in most patients of glaucoma clinically recognizable disc changes precede detectable field loss[10].

Conclusion:

Primary open angle glaucoma is an important cause of irreversible blindness. The proportion and severity of scotomas increases as C/D ratio increases alongwith an increase in Loss Variance. The limitation of the current study is less sample size due to time constraints. It also needs to be mentioned that perimetry is a subjective test so certain patients had unexplainable unusual Loss variance values. On the other hand, data from many patients could not be taken into account due to high RF usually observed in patients with advanced glaucoma with severe cupping. Inspite of this limitation, we observed a statistically significant correlation between cup/disc ratio and probability of abnormal visual field. In this sense, the current study serves to highlight the importance of perimetry at regular intervals on follow up visits in patients with Primary open angle glaucoma. A larger prospective cohort study which corroborates the different fundoscopic findings of disc anatomy and other changes and correlation with visual field analysis at regular intervals would

throw more light in this area. Similarly, it would be interesting to see if the early disc changes, where the perimetry may be normal, show any significant findings in a coherence tomography study or other methods of perimetry.

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