Role of OCT in early detection of Primary Open Angle Glaucoma (POAG)

Swapon Kumar Biswas[1], N.C.Barai[2], Md.Akhtaruzzaman[3], Partha Sarathi Barai[4]

Abstract

Purpose: *To evaluate retinal nerve fiber layer (RNFL) and optic nerve head (ONH) changes in primary open angle glaucoma (POAG) by OCT.*

Methodology: *This prospective observational study was conducted in the department of Glaucoma clinic, National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh during the period of 1st January 2012 to 30th June 2012 on 50 cases of early primary open angle glaucoma ie, glaucoma suspect patient .All patient had a baseline evaluation which included, IOP measurement, angle assessment, anterior & posterior segment assessment including Optic disc ie, Optic Nerve Head (ONH) evaluation. Then assessment of the retinal nerve fiber layer (RNFL) thickness was performed by using a OCT3000 (Humphrey-Zeiss) instrument.*

Result: *Average RNFL thickness among study subjects out of 50 patients, 09 (18%) patients had average RNFL thickness 60 micrometer (ì),17 (34%) had average RNFL thickness between 60-80 micrometer (ì), 24(48%) had average RNFL thickness between 80micrometer (ì). Mean average RNFL thickness was 76.30 ±13.75micrometer (ì) & quadrant wise RNFL thickness among study subjects, mean inferior quadrant RNFL thickness was 81.30 ± 13.38 ì (SD), mean superior quadrant RNFL thickness was 77.98 ±13.57 ì, mean nasal quadrant RNFL thickness was 74.92 ± 13.59 ì and mean temporal quadrant RNFL thickness was 71.92± 13.47 ì.*

Conclusion: *OCT in glaucoma is a excellent effective tool in identifying and obtaining more accurate quantitative data related to ONH and RFNL. Analytical result of this study stabilizes that primary open angle glaucoma cases may have moderate to mark RFNL reduction, though these are not evidenced by perimetry. With an earlier accurate diagnosis and timely therapy, should be preventing glaucoma related blindness the goal for this century.*

Keywords: *RNFL, ONH, OCT, POAG.*

Introduction

Glaucoma is a progressive degenerative optic neuropathy. It is one of the main causes of irreversible legal blindness worldwide and more specifically the second cause of loss of vision in patients over 40 years of age in the developed countries[1], with an important impact on quality of life[2-4]. In the first stages, glaucoma-induced structural alterations (apoptosis of ganglion cells, nerve fiber loss, and optic disc alteration) are asymptomatic and cannot be diagnosed clinically until functional changes are detected such as early scoto as in the visual fields (VF). It has been demonstrated that 40%–50% of axonal loss may occur before any change in visual function is detected with perimetry[5]. Early diagnosis of glaucoma, in the first stages, before VF alterations, permits a more accurate treatment with the goal of functional maintenance and preservation of VF with minimum damage[6-7]. There is sufficient evidence that ocular

1. Assistant Professor (Ophthalmology)& phaco surgeon, OSB Eye Hospital & Institute. Dhaka.
2. Visiting Professor TMSS Medical college, Bogra.
3. Senior Consultant & phaco surgeon, OSB Eye Hospital.Dhaka.
4. Assistant surgeon Netraloy Eyecare. Bogra

Address of Correspondence: Dr. Swapon Kumar Biswas, Assist Professor (Ophthalmology), Medical Vitro-Retina specialist & phaco surgeon, E-mail: skbiswas0507@gmail.com

hypertension therapy reduces the relative risk of conversion to glaucoma by 14% with each mmHg intraocular pressure (IOP) reduction[8]. In different studies, it has been found that the optic disc remains a good and simple means for supervising subjects at risk for and in early diagnosis of chronic open-angle glaucoma. The evaluation of changes in the optic disc is greatly aided by systematic recording of observations[9]. OCT represents a new type of imaging modality of quantitative assessment of nerve fiber thickness and optic disc parameters. It is used as a more sensitive method for the detection of early structural glaucomatous nerve alterations that precede optic disc and VF damage[10]. Glaucomatous optic neuropathy is characterized by progressive thinning of the retinal nerve fiber layer (RNFL). It has been postulated that high-tension primary chronic open angle glaucoma (HT-PCOAG) patients have diffuse functional and morphologic damage to the eye[11-12]. In clinical investigations of high tension glaucomatous RNFL damage using scanning laser polarimetry[13-14], reduction in RNFL thickness were symmetrical in superior and inferior quadrants. In experimental studies[15] besides the diffuse loss of RNFL, localized RNFL defects were present in high tension glaucomatous eyes. It has been speculated that in all types of glaucoma, optic nerve fiber loss might occur in a localized pattern that is too small to detect at an early stage and may only become visible later upon coalescence with disease progression. It is generally agreed that standard conventional visual field may not be sensitive enough to detect early glaucomatous damage, and structural changes such as those in the RNFL usually occur earlier than conventional visual field defects[16]. Recently, the ability to quantitatively and objectively evaluate the RNFL has improved considerably and several new instruments have been developed. One of these, optical coherence tomography (OCT; Humphrey Systems Inc., Dublin, CA) is a noninvasive, noncontact method that allows cross-sectional in vivo imaging of intraretinal layers[17] by measuring the difference of backscattered light at different retinal layers, thus making it possible to assess the RNFL. OCT has been shown to be an objective, reproducible[18-20], and sensitive tool to track RNFL defects in glaucoma[21-25].

Methodology : This prospective observational study was conducted over 50 patients attend in Glaucoma clinic National Institute of ophthalmology and Hospital, (NIO&H) Dhaka.1stJanuary 2012 to 30th June 2012, with glaucoma suspects having IOP more than20 mm of Hg in two successive clinical settings, The assessment of retinal nerve fiber layer thickness was performed using a commercial release of the OCT 3000 (Humphrey-Zeiss Instruments). After triggering pupil dilation with 1% tropicamide, 3 circular optical scanning (which scan RNLF thickness) of 3.4 mm diameter was focused on the optic disc. Two analyses was performed on each of the eyes examined: average thickness of retinal nerve fiber layer; thickness of the fiber layer found on the 4 retinal quadrants (upper: 46135 degrees, nasal: 136-225 degrees, lower: 226-315 degrees; and temporal: 316-345 degrees).

Results : Results have been shown in tabulated form below:

Table-I: ***Age distribution of study subjects.***

Age range	No. of patients	%
30-40 years	08	16
40-50 years	20	40
50-60 years	22	44
Mean age ± SD: 48.64 ± 7.71 years		

Table-I: shows the distribution of age among the study subjects.08 (16%) patients were among 30 – 40 years age group, 20 (40%) patients among 41-50years age group and 22 (44%) were among 51-60 years age group. Mean age was 48.64 ± 7.71(SD) years.

Table-2: ***Sex distribution of study subjects.***

Sex	No. of patients	%
Male	22	44
Female	28	56

Table-2: shows the distribution of sex among the study subjects. Among 50patients, male was 22 (44%) and female was 28 (56 %).

Table-3: ***Distribution of intraocular pressure among study subjects.***

IOP range	No of patients	%
20-25 mm of Hg	27	54
26-31 mm of Hg	16	32
>31 mm of Hg	07	14
Mean IOP ± SD: 16.28 ±3.08 mm of Hg		

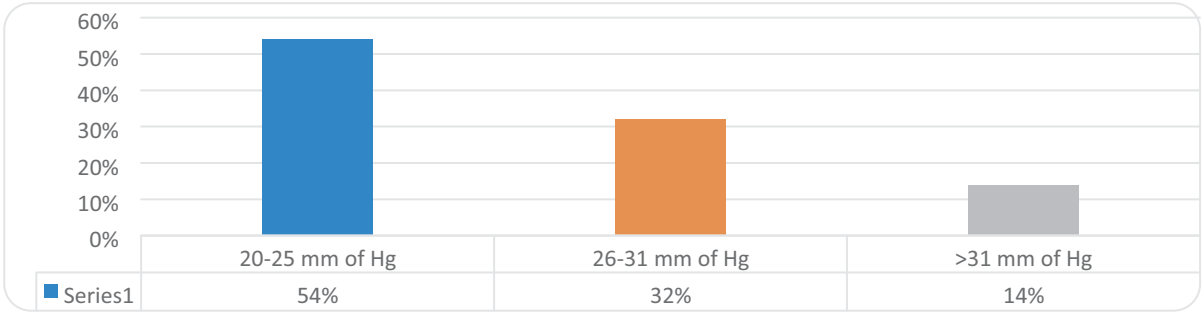

Fig.1: Distribution of intraocular pressure among study subjects.

Table-3 and Fig.1 shows the distribution of intraocular pressure (IOP) among study subjects. Among 50 patients, 27 (54%) patients had IOP between 20-25mm of Hg, 16 (32%) had IOP between 26-31 mm of Hg and 07 (14%) had IOP over 31 mm oh Hg. Mean IOP was 16.28 ±3.08 mm of Hg.

Table-4: ***Distribution of disc features among study subjects.***

Disc feature	No of patients	%
Increased cup-disc ratio with NRR thinning	29	58
Disc notching	13	26
Disc haemorrhage	08	16

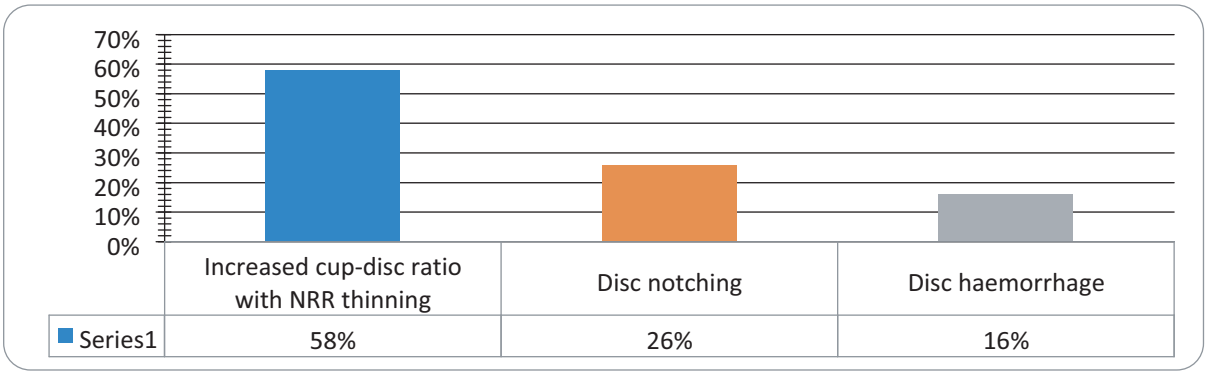

Fig.2; Distribution of disc features among study subjects.

Table-4 and Fig.2 shows the distribution of disc features of the study subjects. Out of 50 patients, 29 (58%) had increased cup-disc ratio with Neuro-retinal rim (NRR) thinning, 13 (26%) had disc notching and 08 (16%) had disc haemorrhage.

Table-5: *Average RNFL thickness.*

Average RNFL thickness	No. of patients	%
< 60 micrometer	09	18
60-80 micrometer	17	34
>80 micrometer	24	48
Mean average RNFL thickness ± SD: 76.30 ± 13.75 micrometer (µ)		

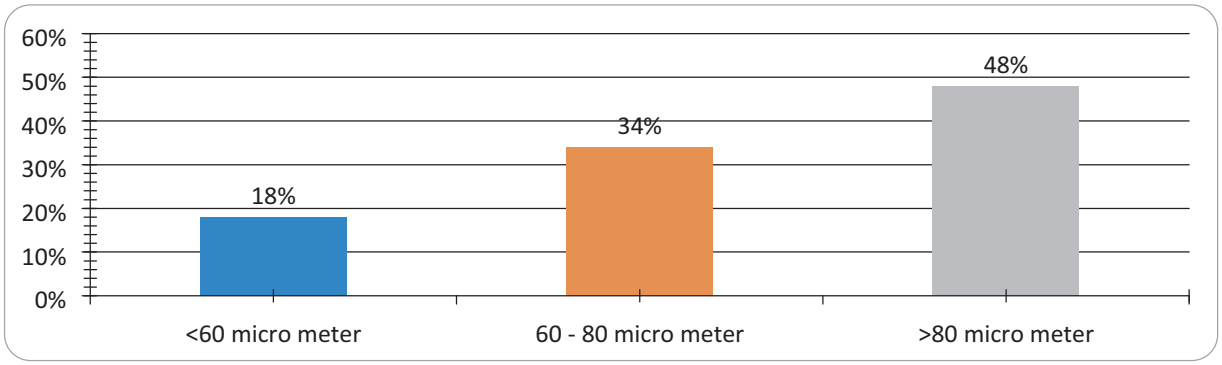

Fig.3; Average RNFL thickness.

Table-5 and Fig.3 shows the distribution of average RNFL thickness among study subjects. Out of 50 patients, 09(18%) patients had average RNFL thickness < 60 micrometer (µ), 17(34%) had average RNFL thickness between 60-80 micrometer (µ) 24(48%) had average RNFL thickness between >80micrometer (µ). Mean average RNFL thickness was 76.30 ± 13.75 micrometer(µ).

Table-6: *Quadrant wise RNFL Thickness.*

Mean RNFL thickness	Mean ± SD
Inferior quadrant	81.30 ± 13.38 µ
Superior quadrant	77.98 ± 13.57 µ
Nasal quadrant	74.92± 13.59 µ
Temporal quadrant	71.92± 13.47 µ

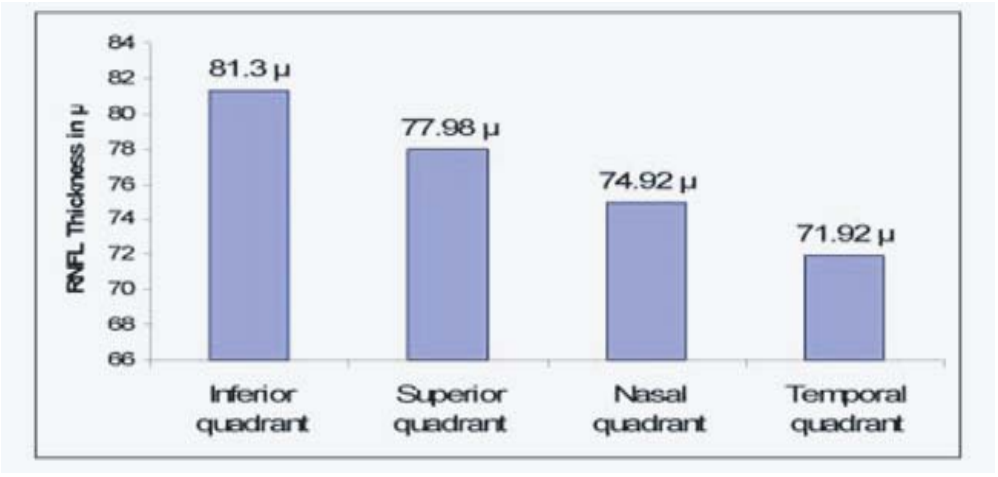

Fig.4: Quadrant wise RNFL Thickness.

Table-6 and Fig.4 shows the distribution of quadrant wise RNFL thickness among study subjects. Out of 50 cases, mean inferior quadrant RNFL thickness was 81.30 ± 13.38 µ (SD), mean superior quadrant RNFL thickness was 77.98 ±13.57µ, mean nasal quadrant RNFL thickness was 74.92 ± 13.59 ì and mean temporal quadrant RNFL thickness was 71.92± 13.47µ.

Discussion

This prospective observational study was conducted in Glaucoma clinic National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh during the period of 1st January 2012 to 30th June 2012 on Early primary open angle glaucoma patients. Early primary open angle glaucoma cases were defined as IOP above 21 mmHg in three separate measurements, suspicious appearance of the optic disc (OD) ie, one of the following: notching, hemorrhage, and suspicious cup: disc (C/D) ratio & thinning of neuro-retinal rim. A total of 50 cases were included in the study. All patients had a baseline evaluation which included IOP measurement, angle assessment, anterior and posterior segment assessment including disc evaluation. Then, the assessment of retinal nerve fiber layer thickness was performed using a e OCT3000 (Humphrey-Zeiss Instruments). Average thickness of retinal nerve fiber layer; thickness of the fiber layer found on the 4 retinal quadrants (upper: 46135 degrees, nasal: 136-225 degrees, lower: 226-315 degrees; and temporal:316-345 degrees). Table-1 shows the distribution of age among the study subjects.. 08(16%) patients were among 30 – 40 years age group, 20 (40%) patients among41- 50 years age group and 22 (44%) were among 51-60 years age group . Mean age was 48.64 ± 7.71 (SD) years. Mayoral et al (2006)17 showed the mean age in their study was 58.61± 9.15. Lalezary et al (2006)18 showed mean age 50.43± 21 in their study[17]. Filho et al showed the mean age 44.2 years in their study[30]. Other studies on glaucoma suspects also reflect age ranging from 45-60 years. Age older than 40 years is a risk factor for the development of POAG, with up to 15% of people affected by the seventh decade of life[32]. Table-II shows the distribution of sex among the study subjects. Among 50 patients, male was 22 (44%) and female was 28 (56 %). Reports on sex predilection differ. Although some age-controlled studies have reported significantly higher mean IOP values in women than in men, others have failed to find such a difference, while others have even shown males to have a higher prevalence of glaucoma. Taliantzis et al. 42 showed male predominance in their study (60& Male, 40% female). Wollstein et al 16 showed 57% female and 43%male in their study. Table-III and Fig.1 shows the distribution of intraocular pressure (IOP) among study subjects. Among 50 patients, 27 (54%) patients had IOP between 10-15mm of Hg, 16 (32%) had IOP between 16-21 mm of Hg and 07 (14%) had IOP over 21 mm oh Hg. Mean IOP was 16.28 ±3.08 mm of Hg. Taliantzis et al 21showed mean IOP 22.16 ± 2.1. Filho et al 30 showed mean IOP 18.75 mm of Hg in their study. Percentage of marked

RNFL loss was observed in studies where mean IOP was more than 21 mm of Hg 43 TableIV and Fig.2 shows the distribution of disc features of the study subjects. Out of 50 patients, 29 (58%) had increased cup-disc ratio with Neuro-retinal rim (NRR) thinning, 13 (26%) had disc notching and 08 (16%) had disc haemorrhage. It has been shown that increased cup-disc ratio with NRR thinning was the commonest features in different studies 44. Table -V and Fig.3 shows the distribution of average RNFL thickness among study subjects. Out of 50 patients, 09 (18%) patients had average RNFL thickness < 60 micrometer (µ), 17 (34%) had average RNFL thickness between60-80 micrometer (ì) 24(48%) had average RNFL thickness between >80micrometer(ì). Mean average RNFL thickness was 76.30 ± 13.75 micrometer (µ). Aydin et al31 showed mean RNFL thickness 72.8 ± 20.5µ in their study. Wollstein et al16 showed mean RNFL thickness 93.97µ in glaucoma suspects cases. Bendschneider et al (2010)32 showed mean RNFL thickness 97.2±9.7µm. Wollstein et al (2011) 45 showed mean RNFL thickness was 75.3ìm. Table - VI and Fig.4 shows the distribution of quadrant wise RNFL thickness among study subjects. Out of 50 cases, mean inferior quadrant RNFL

thickness was 81.30 ± 13.38µ (SD), mean superior quadrant RNFL thickness was 77.98 ±13.57µ, mean nasal quadrant RNFL thickness was 74.92 ±

13.59µ and mean temporal quadrant RNFL thickness was 71.92± 13.47µ. Wollstein et al(2011)33 showed that mean Superior RNFL thickness 83ìm, inferior 87µm,nasal 70ìm and temporal 51ìm. Aydin et al 41 showed that mean Superior RNFL thickness 87.9µm, inferior 85.9µm, nasal 55.3µm and temporal 61µm. In this study glaucomatous patients were also included. Filho et al 30 showed that mean Superior RNFL thickness 105µm, inferior 97µm, nasal 48µm and temporal 41µm. In glaucomatous case altered thickness pattern has been observed. Out of 50 patients, 09 (18%) were diagnosed as having glaucoma on the basis RNFL thickness reduction (RNFL thickness <60 µ). (Wollstein et al (2011) 45 observed 17.3% cases in their case series having marked RNFL loss and detected as having glaucoma. OCT is not the only tool for early diagnosing of glaucoma; there are other tools too. Automated perimetry is the important tool for functional assessment of RNFL loss. But it becomes effective after marked RNFL damage. This study was conducted to see the RNFL thickness status in glaucoma suspect cases (early POAG) where perimetric appearance still not in favour of glaucoma.

Conclusion

OCT is a useful instrument that allows early detection of RNFL as well as optic nerve head defects, and facilitates their follow-up over time. This study will be conducted to detect changes that occurs in RNFL and ONH in patients with early POAG by OCT and thereby assessment of their visual prognosis. The aim of the study is to compare and review the finding of other study, done by other authors.

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