Correlation between Visual Field Sensitivity and Retinal Nerve Fiber Layer Thickness in patients with Primary Open Angle Glaucoma

Mohamed Abdel Hamid Abo Elenine, MD

Ophthalmology Department Faculty of Medicine, Al Azhar University

Abstract: Aim of the work: To correlate the glaucomatous loss in Retinal nerve fiber (RNFL) thickness, measured with optical coherent tomography (OCT) and the loss in sensitivity measured with standard automated perimetry (SAP). **Patients and methods:** Thirty six eyes of 20 patients with medical control primary open angle glaucoma (POAG) attending Sayed Galal university hospital from September 2012 till May 2013. All patients examined by Octopus 101 perimeter to examine central 30° visual field. Reliable tests was defined as one with false positive error <15% and false negative error <15% and fixation less <20%. All patients also examined by OCT with spectral domain RNFL Thickness average analysis report using fast RNFL Thickness scan with 3D scanning over optic disc after dilatation with 1% tropicamide, Images were recorded by single operator. A circular scan of 3.4mm diameter was centered around optic nerve head(ONH). **Results:** Thirty six eyes of 20 patients with primary open angle glaucoma under medical treatment. Mean RNFL thickness: ranged between 66, to 120μm with a mean 94.1±16.7μm. Correlation analysis determining the relationship between average RNFL thickness and different perimetric stages of glaucoma using MD and LV indices shows significant inverse correlation. **Conclusion:** OCT can be used as a primary measure of glaucoma status in patients who are unable to perform functional test as visual field,also OCT RNFL thickness used as an adjunct to visual field in diagnosis and monitoring glaucoma progression. [Mohamed Abdel Hamid Abo Elenine. **Correlation between Visual Field Sensitivity and Retinal Nerve Fiber Layer Thickness in patients with Primary Open Angle Glaucoma.** *J Am Sci* 2013;9(11):282-286]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 37

1.Introduction:

Glaucoma is an optic neuropathy with progressive neuroretinal rim thinning excavation, and loss of retinal nerve fiber layer[1].

The structural changes are accompanying by functional losses. The most common test used to detect and follow up glaucoma is standard automated perimetry (SAP). Experimental studies have shown that 40% to 50% of Retinal Ganglion Cells (RGCs) may need to be lost before the decrease in threshold sensitivity exceed normal variability and reaches statistically significant[2].

SAP losses are still the best method to quantify the effect of the disease and to monitor its progression.

Optic coherence tomography (OCT) is non invasive, non contact technique for imaging the layered structure of the retina.

Some studies suggest that (OCT) may be superior to other imaging technique for detecting a specific pattern of reduction in the average or focal (RNFL) thickness[3].

Aim of the work:

To correlate the glaucomatous loss in Retinal nerve fiber (RNFL) thickness, measured with Optical Coherent Tomography (OCT) and the loss in sensitivity measured with Standard Automated Perimetry (SAP).

2.PATIENTS AND METHODS:

Thirty six eyes of 20 patients under medical control for primary open angle glaucoma (POAG) attending Sayed Galal university hospital from September 2012 till mayo 2013d in were include this study.

2.Patients selection:

The inclusion criteria:

- Primary open angle glaucoma.
- Age ranged from 35years to 70 years
- Best corrected visual acuity of 6/18 or better.

Exclusion criteria:

- Advanced glaucomatous damage that interfere with visual field plotting.
- History of previous intraocular disease or operations.
- Corneal or lens opacity that interfere with clinical evaluation of the retina.

All patients examined by Octopus 101 perimeter to examine central 30° visual field. Reliable tests was defined as one with false positive error <15% and false negative error <15% and fixation less <20%.

All patients also examined be OCT with spectral domain RNFL Thickness average analysis report using fast RNFL Thickness scan with 3D scanning over optic disc after dilatation with 1% tropi camide . A

circular scan of 3.4mm diameter was centered around Optic Nerve Head(ONH).

This study to evaluate the ability of OCT to evaluate glaucomatous eyes in its various stages of functional damage using average RNFL thickness between patients with mild, moderate and severe glaucoma with visual field loss, also to determine the correlation between visual field parameter mean deviation (MD) and loss variance (LV) of Octopus perimetry and average peripupillary RNFL thikness as measured by OCT.

3. Results:

This work included 36 eyes of 20 patients with primary open angle glaucoma under medical treatment with the following criteria:

- Age ranged between 35 to 70 years with a mean of 55±12.5 years.
- Gender distribution was 8 females (40%). 12 males (60%)
- Glaucoma duration ranged between 1 month and 7 years with a mean of 3.6±2.5 years.
- Intraocular pressure measured with applanation tonometery ranged between 18 and 25mmHg with a mean of 21.5±2.1 mmHg.
- C/D ratio detected clinically ranged between 0.3 and 0.8 with a mean of 0.52±0.15

Visual field data obtained includes:

MD which ranged between -2 to 9.5 with a mean of 5.3±2.65

MS which ranged between 6.6 to 31.6 with a mean 26.6±3.3

LV which ranged between 0.3 to 110 with a mean 30.5±18.5.

OCT data obtained included:

Mean RNFL thickness: ranged between 66, to 120μm with a mean 94.1±16.7μm.
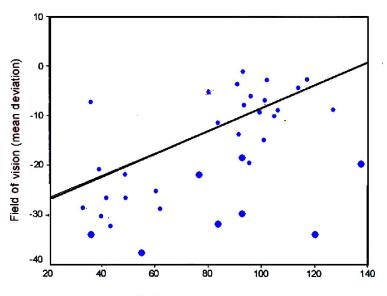
Correlation analysis determining the relationship between average RNFL thickness and different perimetric stages of glaucoma using MD and LV indices shows significant inverse correlation. The highest correlation was found between the average RNFL thickness and MD (r= 0.73).

Strong negative linear correlation between average peripapillary RNFL thikness and MD and LV.

Scatter plot MD and LV values against RNFL thickness showed negative correlation, figure (1).

Table (1): Field defect distribution in glaucomatous eyes.

Field defect	N (%)
Upper nasal	2 (5.5%)
Upper nasal + upper temporal	10 (27.7%)
Seidle scotoma	6 (16.6%)
Upper and lower arcuate	3 (8.3%)
Tubular field	10 (27.7%)
Double arcuate	2 (5.5%)
Upper and lower nasal step	3 (8.3%)

Fig. (1): Relation between field of vision (mean deviation) and RNFL(average thickness) in glaucomatous patients.
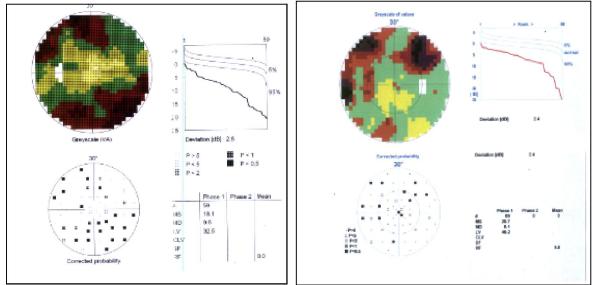
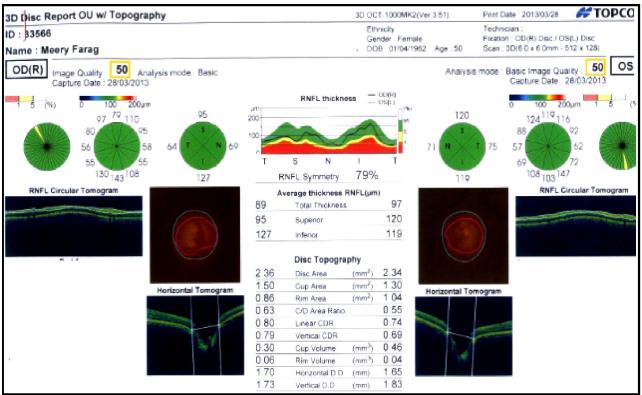**Fig. (2):** Moderate field defect of both eyes.

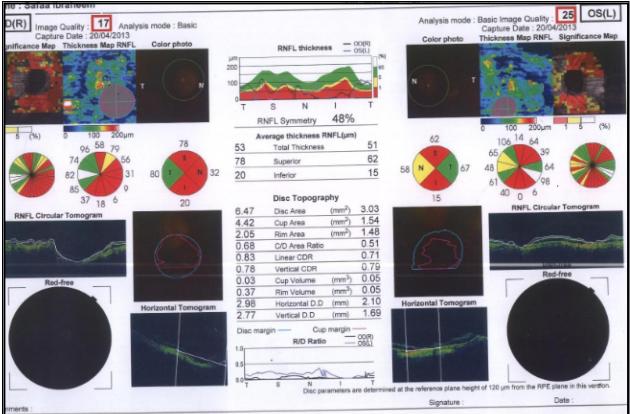**Fig. (3): Normal thicknesof all quadrant of RNFLof both eyes.**

Fig. (4): Thining of RNFL in superior,nasal and inferior quadrant in rt eye and thining of superior and inferior quadrant of RNFL in lt eye.

4.Discussion

By providing objective, quantitative and reproducible measurements of RNFL thickness, OCT provides supplemental information that help to differentiate glaucomatous eyes from normal eyes[4].

In the current study OCT used with perimetry in all cases .The diagnostic performance of structural tests such as OCT RNFL thickness may be more critical for early glaucoma diagnosis compared with late glaucoma as it is easier with more obvious clinical evidence of cupping and functional visual field abnormality.

Retinal gangling cells need to be lost before detectable changes observed in the visual field, evidence of structural damage to optic disc and RNFL has been demonstrated in patients with statistically normal visual field.

Visual field testing remains one of the main methods to monitor patients with glaucoma. Visual field testing needs to be repeated to detect glaucoma progression, also repeating visual field tests several times are needed to detect smaller progression of glaucoma[5].

OCT RNFL thickness used as an adjunct to visual field testing in monitoring glaucoma progression. It can also be a primary measure of glaucoma status in patients who are unable to perform repeated visual field testing[6].

OCT provides quantitative and objective information of RNFL thickness, also RNFL thickness is acquired rapidly and not require pupillary dilatation. OCT measurement are not affected by refractive errors and corneal birefringences [7].

Chen and Huang [8] showed that average RNFL was the best parameter for differentiating early glaucoma from normal. *Sihota et al.* [9] found that average RNFL thickness followed by inferior RNFL thickness had the highest power to discriminate between early glaucoma and normal eyes. .

Kaw et al. found correlation between visual field indices (MD, CPSD) and the average RNFL there were significant positive correlation with MD and a significant negative correlation with CPSD[6]. .

This study results are in agreement with Anita and associate[10] that showed the (RNFL) in the inferior quadrant and temporal quadrant had the highest discrimination ability between normal and glaucomatous eyes.

Also the results are in agreement with Medeiros and associate[11] and with Nouri and associates[12] that temporal quadrant come after inferior quadrant and average RNFL thickness used discrimination between

normal and glaucomatous eyes. Nerve fiber layer thickness (RNFL) as measure by OCT showed statistically significant correlation with glaucoma and have utility in clinical assessment of glaucoma as reported by *Schmidt* [13]**.** Additional benefit of OCT over field is overlapping of neurological diseases and some systemic disorder may affect visual field test but not affect OCT.

Conclusion

OCT RNFL thickness used as an adjunct to visual field in diagnosis and monitoring glaucoma progression, also OCT can be used as a primary measure of glaucoma status in patients who are unable to perform functional test as visual field reliability.

References:

1. **Jonas JB, Budde WM, Panda-Jonas S.** Opthalmoscopic evaluation of the optic nerve head. Sur V. Ophthalmol, 1999; 43: 293-320.
2. **Harweth RS, Wheat JL, Fredette MJ, Androson DR.** Linking Structure and functioning in glaucoma Prog Retina Eyes Res, 2010, 29 (4): 249-271.
3. **Bowd C, Weinreb RN, Williams Jm,** *et al.* The retinal nerve fiber layer thickness in ocular hypertensive, normal and glaucomatous eyes with optical coherent tomography. Arch – Opththalmol 2000; 118: 22-26.
4. **Sehi M, Grewal DS, Sheets CW, Greenfield DS.** Diagnostic ability of Foureir – Domain vs. Ttime Domain Optical Ccherence Tomography for glaucoma detection. Am. J. Opthalmol 2009; 148 (4) 597-605.
5. **Chauhan BC, Garway Health DF, Gori FJ** *et al.* Practical recommendations for measuring rates of visual field change in glaucoma. Br J. Ophthalmol. 2008 92(4): 569-573.
6. **Kaw SM, Martinez JM, Tumbocon JA, and Antieza NJ.** Correlation of average RNFL thickness using Stratus OCT with the perimetric staging of glaucoma Philip J Ophthalmol, 2012, 27. 19-23.
7. **Bowd C, Zangwill LM, Berrry CC.** Detection of early glaucoma by assessment of retinal nerve fiber layer thickness and visual function. Invest Ophthalmol Vis,Sci. 2001, 42: 1993-2003.
8. **Chen HY and Huang ML** discrimination between normal and glaucomatous eyes using sStratus optic coherence tomography in Taiwan chinese subjects. Graefe Arch, Clin Exp. Ophthalmol 2005; 243, 894-902.
9. **Sihota R, Sony P, Gupta V,** *et al.* Diagnostic capability of OCT in evaluating the degree of glaucomatous retinal nerve fiber damage.Invest Ophthalmol Vis Sci 2006,47:2006.10
10. **Manassakom A, Nouri-Mahadvi K, Caprioli J** *et al.* Comparison of retinal nerve fiber layer thickness and optic disk alogorithms with optical coherent tomography to detect glaucoma. Am. J. Ophthalmol 2006, 141: 105-115.
11. **Medeiros FA, Zangwill LM, Girkin CA, Liebmann JM And Weinreb RN.** Evaluation of retinal nerve fiber layer, optic nerve head, and macular thickness measurements for glaucoma detection using optic coherence tomography. Am J Ophthalmol, 2005; 139: 44-55.
12. **Nouri M, Hoffman D, Tannenbaum DP** *et al.* Identifying early glaucoma with optical coherence tomography. Am. J. Ophthalmol, 2004; 137: 228-235.
13. **Schmidt U.** Macular thickness for glaucoma diagnosis. German – Klin Monbl Augenheilked. Dec; 227 (12) 981-6. Epub 2010 Mar. //247.

10/28/2013