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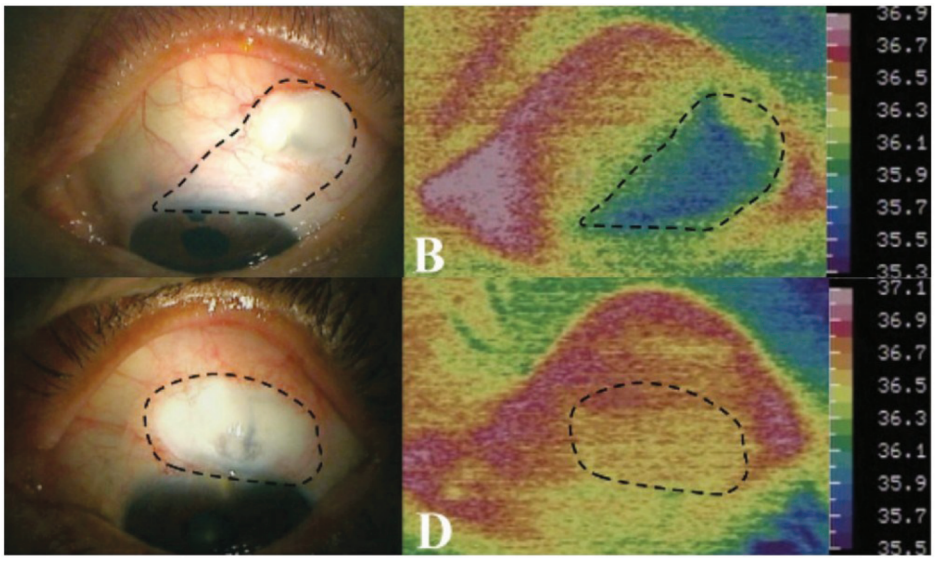
BULGARIAN FORUM GLAUCOMA

БЪЛГАРСКИ ФОРУМ ГЛАУКОМА



Edition of the „National Academy Glaucoma“ Foundation

BULGARIAN FORUM
GLAUCOMA
Edition of the „National Academy Glaucoma" Foundation, Sofia, Bulgaria

СЪДЪРЖАНИЕ

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Contact information: e-mail: botio.ang@abv.bg

Visual field defects and nerve fiber layer thickness determined by OCT in glaucoma patients

K. Buzarovska, M. Golubovic

University Eye Clinic, Skopje, Macedonia

Abstract

Purpose: The purpose of this study was to compare visual field (VF) alterations with optical coherence tomography (OCT) findings in patients with chronic open-angle glaucoma and normal age matched controls.

The dilemma: Do all the patients examined in specialist departments as suspects (only elevation in IOP and VF defects) need OCT? The facts: We have new technology equipment, a large number of undiagnosed, mistreated, or new patients in the terminal stage of glaucoma. By using OCT, it's easy to do the imaging, but not cheap for limited budgets. The usefulness of OCT imaging should be to help us decide along with other tests what to do with a "suspect", "probable" or "possible" patient with glaucoma.

Materials and method: Visual field parameters and OCT retinal nerve fiber layer (RNFL) measurements of 30 eyes of 28 glaucoma patients with various stages of glaucoma were compared with 20 eyes of 20 normal age-matched controls. The RNFL thicknesses measured in glaucoma and control subjects were used to determine local thickness deviation in all 12 sectors. Description of the results includes mean and standard deviations. RNFL reduction was calculated in absolute (micrometers) and in relative (percentage) values. Correlations of RNFL thicknesses with corresponding visual field defects were examined by using Spearman rank test.

Results: Mean sectoral thicknesses, as measured with OCT, ranged from 60 to 144 micron in the control eyes and from 49 to 87 microns in the glaucomatous eyes. Average RNFL thickness was 70.01+/-14.39 micron in the glaucoma group and 110.01+/-6.00 micron in the control group ($P<0.05$). Pattern standard deviation and mean deviation visual field zones and corresponding OCT RNFL thickness sectors were significantly correlated at specific sectors in the glaucoma group ($P<0.01$).

Conclusion: An optic disc evaluation and VF test are sufficient to diagnose glaucoma in most cases. However, OCT can play an important role in detecting glaucoma in cases in which it cannot be identified by optic disc examination and VF. Analysis of RNFL thickness in eyes with glaucomatous visual field defects showed good structural and functional correlation with OCT. Both OCT and HRT showed early ONH and RNFL changes in their parameters and correlated with the findings of the automated perimetry. OCT contributes to the identification of focal defects in the RNFL of glaucoma patients.

Key words: glaucoma, visual field, RNFL, OCT.

Introduction

Glaucoma is a multifactorial optic neuropathy known to cause progressive loss of retinal ganglion cells and their axons. Evaluation of the retinal nerve fiber layer (RNFL) and optic nerve head (ONH) is a crucial step in diagnosing and monitoring glaucoma. It has been suggested that early detection and treatment of glaucomatous optic neuropathy may reduce the incidence of blindness from glaucoma. Staging glaucomatous damage into broad categories of damage such as, mild, moderate and advanced, enhances management. It promotes careful assessment and documentation of clinical damage, thereby facilitating the monitoring of stability versus progression and provides a common language for both clinical and research purposes [1, 2, 3].

Automated computerized devices can discriminate between normal and glaucomatous eyes, objectively with good results. These include scanning laser ophthalmoscopy, scanning laser polarimetry and optical coherence tomography (OCT). Each one of these devices can analyze and quantify the optic nerve and RNFL thickness allowing broad staging of structural damage. However, these expensive and sophisticated technologies are evolving faster than clinical assessment of their utility. The recently introduced spectral domain OCT (SD-OCT) system is a rapidly emerging imaging modality in diagnosing glaucomatous damage. It is particularly valuable in glaucoma detection and monitoring through identification of subtle RNFL or ONH changes over time. However, the role of OCT remains less certain in eyes with early damage. Although several studies addressed the discriminating ability of OCT in glaucomatous eyes, its role in differentiating glaucomatous stages has not been well-established yet.

As a progressive degenerative neuropathy, glaucoma is one of the main causes of irreversible blindness in patients over 40 years of age in developed countries, with an important impact on quality of life. In the intial stages, glaucoma-induced structural alterations (apoptosis of ganglion cells, nerve fiber loss,

and optic disk alterations) are asymptomatic and cannot be diagnosed clinically until functional changes are detected such as early scotomas in the visual field [4, 5].

SD-OCT represents a relatively new type of imaging modality of quantitative assessment of nerve fiber thickness and optic disk parameters. It is used as a more sensitive method for the detection of early structural glaucomatous nerve alterations that precede optic disk and VF damage.

The purpose of this study was to compare VF alterations with SD-OCT findings in patients chronic open-angle glaucom, and normal age-matched controls.

The dilemma: Do all the patients examined in specialist ophthalmology departments as suspects (presenting with only IOP elevation and VF defects) need OCT?

The facts: We haveanew technology equipment, a very large number of undiagnosed, mistreated, or new patients in the terminal stage of glaucoma. By using SD-OCT, it's easy to do the imaging, but an the same time it's expensive for our limited budgets.

The usefulness of SD-OCT imaging should be to help us, among other tests, to decide what to do with a patient presenting as a "suspect", "probable" or "possible" case of glaucoma.

Material and methods

We have examined 30 eyes of 28 glaucoma patients in our retrospective-prospective study performed at the OCT cabinet in the University Eye Clinic, Skopje.

Perimetry was performed with Optopol perimeter, glaucoma testing and OCT by Topcon tomography with glaucoma analysis disc topography.

Visual field parameters and SD-OCT RNFL measurements of 30 eyes of 28 glaucoma patients with various stages of glaucoma were compared with 20 eyes of 20 normal age-matched controls.

Inclusion criteria: Primary open angle glaucoma, Best-corrected visual acuity 0.5 (20/40) or better, Spherical refractrive

Table. 1. Demographic data of the groups.

	Glaucoma group	Control group
Age	66.5	64.3
Gender (F/M)	16/12	12/8
IOP	22 - 24 mmHg	17 mmHg
C/D	0.56	0.34

error within ± 4 diopters and cylindrical refractive errro within ± 1 diopter.

Exclusion criteria: history of intraocular diseases, intraocular surgery, cataract, coexisting retinal diseases, other diseases affecting VF.

A perimetric nerve fiber bundle map was built by dividing the visual field area into 21 zones.

Mean deviation and pattern standard deviation values within these 21 zones were compared with SD-OCT RNFL thickness measurements in the corresponding 12 sectors and the results were analyzed (Fig. 1).

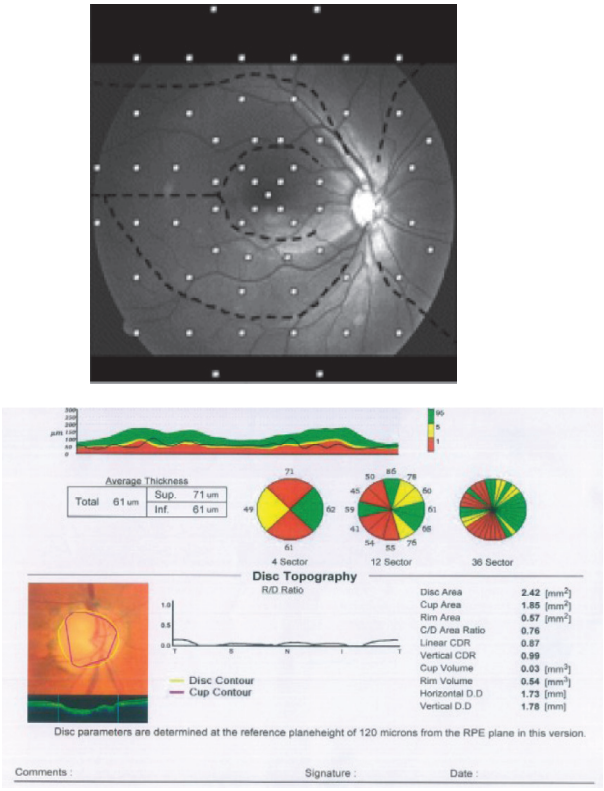


Fig. 1. Topography of the nerve fibers and perimetric test points.

Visual field areas and optic disc segmentation.

In this study we used the areas of visual field defects based on local perimetric test positions arranged according to the course of the nerve fibers:

1. central position (15° - 34°); 2. nasal-inferior (34° - 79°);
3. inferior (79° - 124°); 4. temporal (124° - 225°);
5. superior (225° - 270°); 6. nasal-superior (270° - 315°)

Peripapillary zones were based on the calculation of RNFL thickness in 15 sectors.

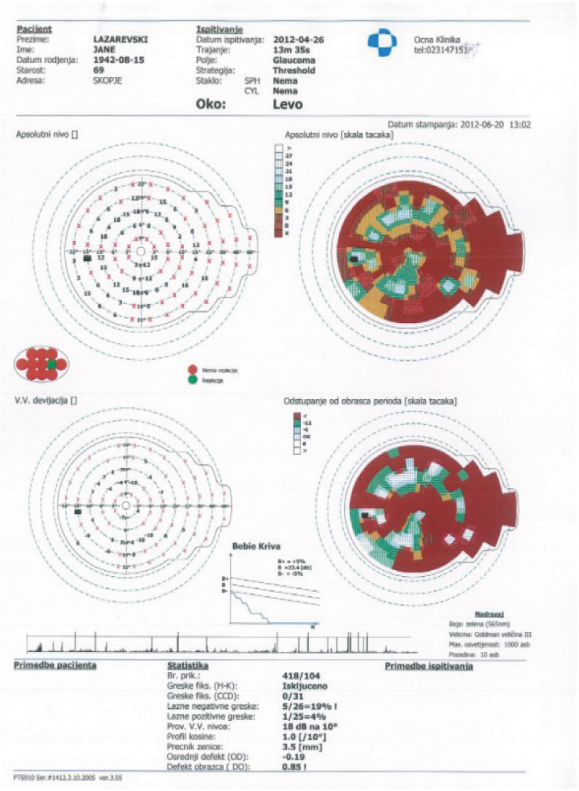
To calculate the mean visual field loss in these six areas, we calculated the anti-log values at all single test positions and averaged them.

For presentation and statistical analysis, these averaged values were converted back to decibel scale. The RNFL thicknesses measured in glaucoma and control subjects were used to determine local thickness deviation in all 12 sectors. Description of the results includes mean and standard deviations. RNFL reduction was calculated in absolute (micrometers) and in relative (percentage) values. Correlations of RNFL thicknesses with corresponding visual field defects were examined by using Spearman rank test.

Results

To study the relationship between nerve fiber damage and perimetric defects in nerve fiber bundle-related areas, we calculated the deviations from measurements in normal subjects.

Mean sectoral thicknesses, as measured with SD-OCT, ranged from 60 to 144 microns in the control eyes and from 49 to 87 microns in the glaucomatous eyes.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Ime: JANE
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Starost: 69
Adresa: SKOPJE
Ispitivanje
Datum ispitivanja: 2012-04-26
Trajanje: 13m 35s
Polje: Glaucoma
Strategija: Threshold
Staklo: SPH Nema
CYL Nema
Oko: Levo
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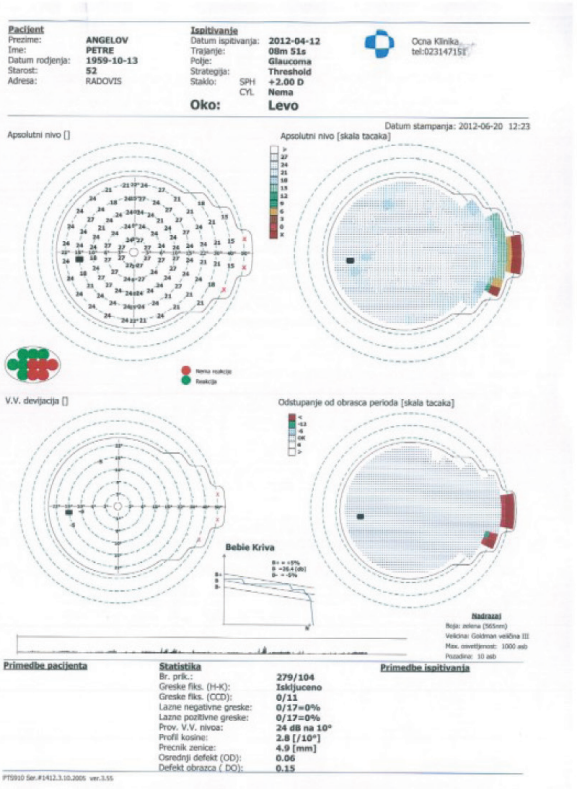
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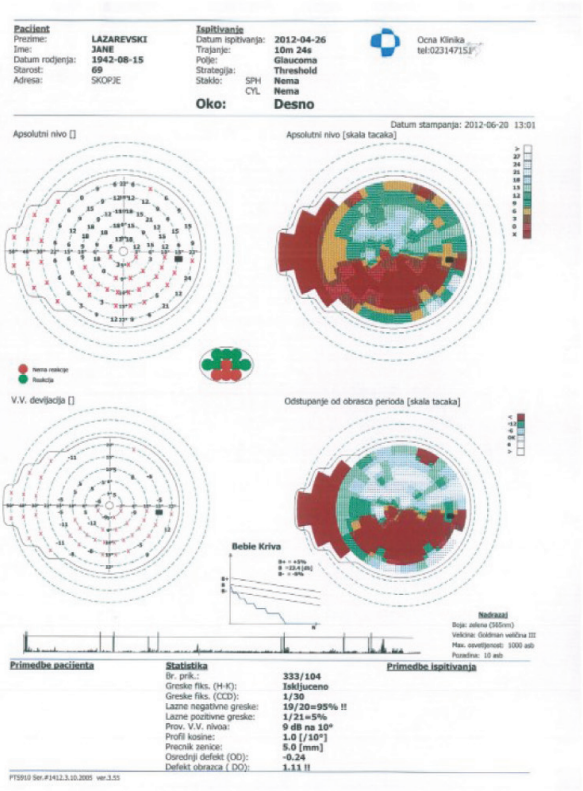
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Polje: Glaucoma
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CYL Nema
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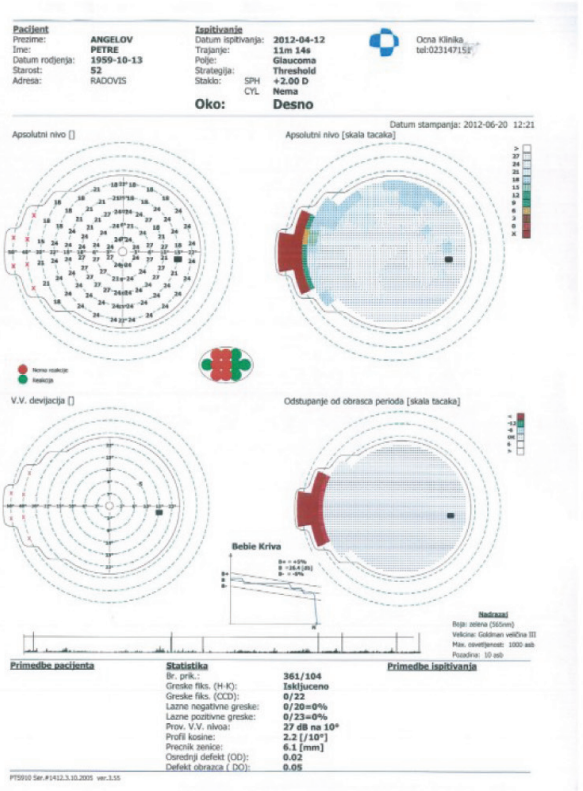
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Lazne pozitivne greske: 0/23=0%
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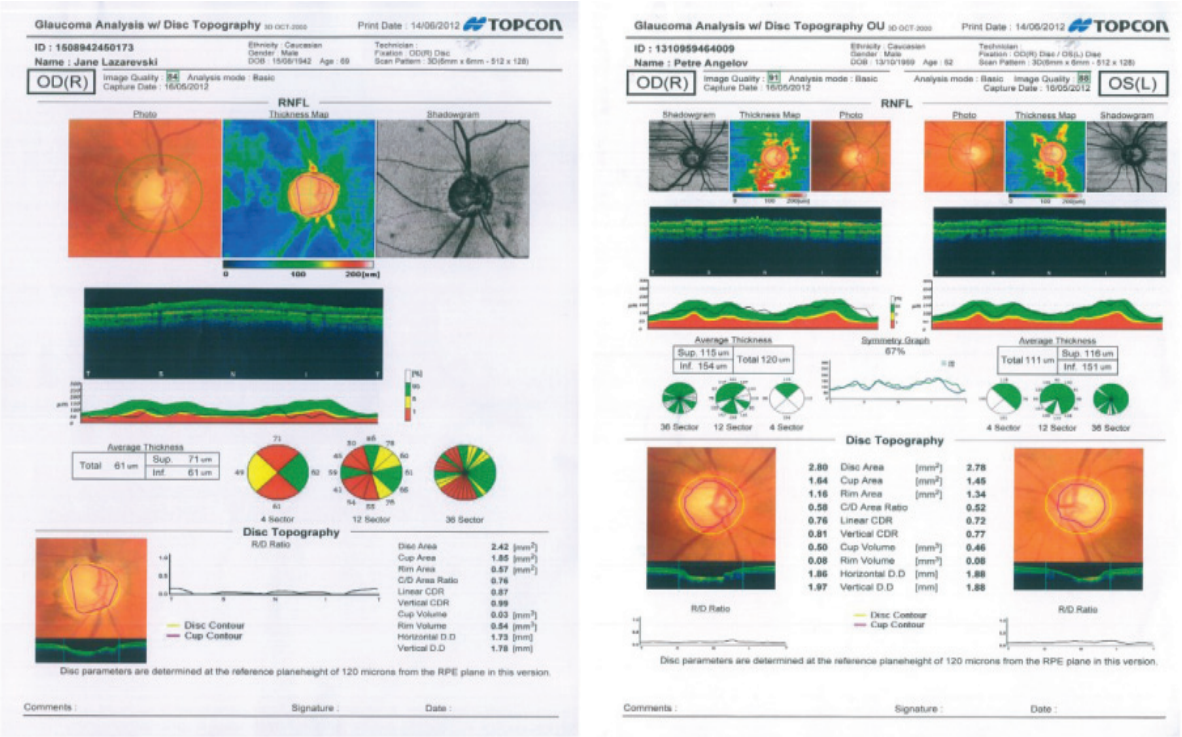

Fig. 2. Representative SD-OCT and visual field results in glaucoma patients.

Average RNFL thickness was 70.01+/-14.39 microns in the glaucoma group and 110.01+/-6.00 microns in the control group (P<0.05).

In this theoretical model, the local correlation analyses indicated that focal perimetric defects could be correlated to measurements of nerve fiber losses if they occur in visual fields areas corresponding to the vascular arcades.

Pattern standard deviation and mean deviation in visual field zones and corresponding OCT RNFL thickness sectors were significantly correlated at specific sectors in the glaucoma group (P<0.01).

OCT indicated a loss of more than 50% of the normal RNFL thickness in cases with advanced glaucoma, which were detected by perimetry and evaluation of the optic nerve head.

Discussion

In many practical aspects of ophthalmology, it is necessary to assess the degree of severity in glaucoma cases where, for various reasons, it is impossible to perform a visual field test - static perimetry. These are cases in which the visual field test result is not reliable, e.g. advanced age-related macular degeneration (AMD). In these cases, there is a need to determine the severity of glaucoma, mainly on the basis of optic nerve head (ONH) and retinal nerve fibre layer (RNFL) structure [6]. OCT is one of the diagnostic methods capable of analysing changes in both, ONH and RNFL in glaucoma [8 - 12]. According to Suh [6], who took one hundred sets of disc photographs, VF tests, and OCT images, which were presented consecutively to seven ophthalmologists. Each set was provided in three steps and kappa statistics were used to assess the intraobserver and interobserver agreement, as well as the agreement with the reference standard. The intraobserver agreement was almost perfect in this study and did not change markedly with the addition of diagnostic tools. The interobserver agreement increased from 0.54 to 0.61 when VF was added and increased slightly to 0.63 with OCT [7, 8]. The agreement with the reference standard also increased significantly from 0.48 to 0.61 after adding VF and increased slightly with additional OCT. In our study, we identified early glaucoma defects in SD-OCT results in 15 eyes (50%) of the examined patients where visual fields had no defects. Although 7.0% of eyes had no RNFL thinning, 45.7% had ONH surface depression at the onset of RNFL thinning. Visual acuity of eyes in patients with ONH surface depression was significantly worse compred to eyes of patietns with RNFL thinning (P = 0.002). With reference to the VF and SD-OCT, ONH surface depression occurred before RNFL thinning in a significant proportion of patients with glaucoma. A time window for therapeutic intervention may exist for detection of ONH surface depression before there is observable RNFL thinning in glaucoma.

Conclusion

An optic disc evaluation and VF test are sufficient to diagnose glaucoma in most cases. However, SD-OCT can play an important role in detecting glaucoma in cases in which it cannot be identified by optic disc examination and VF. Analysis of RNFL thickness in eyes with glaucomatous visual field defects showed good structural and functional correlation between VF and SD-OCT. SD-OCT results showed early ONH and RNFL changes in patients with glaucoma, which were correlated with the findings of the automated perimetry. SD-OCT contributes to the identification of focal defects in the RNFL of glaucoma patients.

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