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Visual field damage and progression in glaucomatous myopic eyes

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PURPOSE. *To make a visual field retrospective analysis on a group of patients with primary open angle glaucoma (POAG) and to evaluate whether different refractive errors could have different progression of the 30° central sensitivity.*
METHODS. *A total of 110 patients with POAG (52 men and 58 women) were included in the study. All the patients were divided into four subgroups based on the refractive error. The visual field of all the included patients was assessed by an Octopus 30° central visual field every 6 months, for a total of 837 visual fields examined. The resulting data were analyzed by PERIDATA for Windows 1.7 TREND function. Mean defect (MD) and loss variance (LV) were considered for the analysis.*
RESULTS. *At the first examination, 82% of eyes showed a global decrease of differential light sensitivity (MD >2 dB) and in 67% the distribution of the defect was nonhomogeneous (LV >6 dB). The analysis of variance for subgroups showed a more significant decrease of MD in highly myopic patients. A linear regression analysis highlighted a statistically significant change in time of MD in 36% and of LV in 34% of the eyes studied. Highly myopic patients had the highest ($p<0.01$) percentage of change of MD and LV (46% and 42%, respectively). Among the four subgroups, there was no difference in progression of MD decrease in time.*
CONCLUSIONS. *These results showed that after 5 years of glaucoma, the visual field was altered in most of the eyes examined (82%) and that in 67% of cases, its defect was nonhomogeneous and worsened with the increase of myopia. The regression linear analysis of visual field changes in time showed a progressive increase of MD and LV in approximately one third of all the eyes examined. (Eur J Ophthalmol 2007; 17: 534-7)*

KEY WORDS. *Glaucoma, Myopia, Visual field progression*

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INTRODUCTION

Glaucoma is one of the leading causes of blindness in adults and in most cases, it presents no symptoms until the last stages of the disease. The association of high myopia with glaucoma is not accidental and these two pathologies are strongly related. The incidence of open angle glaucoma in myopia is unclear, varying from 2.8% to 28.5% (1). All types of glaucoma are more frequent in myopic eyes than in emmetropic eyes and the risk factor of developing glaucoma is related to the degree of myopia (2, 3) and intraocular pressure (IOP) is higher in myopic eyes (4-7). Furthermore, myopia is more frequent in patients with primary open angle glaucoma (POAG) than in nonmyopic subjects.
According to the definition of the European Glaucoma Society, PAOG is a chronic, progressive optic neuropathy characterized by intraocular pressure (IOP) >21 mmHg without treatment, acquired characteristic glaucomatous damage to the optic nerve head and/or retinal nerve fiber layer changes (diffuse or localized defects), open angle at gonioscopy, and glaucomatous visual field defects corresponding to the optic disc damage. The relative risk for POAG progression rises continuously with

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the level of IOP (8).
The aim of our study is to make a visual field retrospective analysis on a group of patients with POAG with IOP under therapy <20 mmHg and to evaluate whether different refractive errors could have different progression of the 30° visual field perimetry.

METHODS

The research followed the tenets of the Declaration of Helsinki and informed consent was obtained from all the subjects. A total of 110 patients with POAG (52 men and 58 women) were included in this study. Their ages ranged from 25 to 71 years (56.7±12.8). The corrected visual acuity of all selected patients was at least 20/40. Refractive error was assessed by an examination with autorefractometry (Nydek AR 1000) in cycloplegia as it was shown to be more accurate in the estimate of dioptrics when compared to autorefractometry without cycloplegia or to subjective measurement (9).
Patients with cataracts that were clearly recognizable during slit lamp examinations were excluded from the study (n=11) to reduce the effects of preretinal factors on visual field results.
Patients were classified as having POAG when they had typical glaucomatous visual field defects in three consecutive tests and/or a typical abnormal optic nerve head, open angle at gonioscopy, IOP >21 mmHg with no treatment, and no clinically apparent secondary cause for glaucoma.
Visual field test was performed by using Octopus perimetry 1-2-3 G1 program (Interzeag AG, CH-8952 Schlieren, Switzerland).
A glaucomatous visual field defect was defined as 1) three adjacent points depressed by 5 dB, with one of the points depressed by at least 10 dB; 2) two adjacent points depressed by 10 dB; or 3) a 10 dB difference across the nasal horizontal meridian in two adjacent points. None of the points could be edge points unless immediately above or below the nasal horizontal meridian. In addition, visual field testing was considered reliable only when false-negative responses were less than 30% and fixation losses were less than 20% (10). Mean defect (MD), loss variance (LV), and corrected loss variance (CLV) were considered in the study.
The abnormal optic nerve head classification was based on the presence of vertical cup/disc diameter ratio asymmetry unexplained by side differences in optic disc size, disc hemorrhage, optic rim notch, or diffuse/generalized loss of optic rim tissue.
All the patients were under hypotensive monotherapy with beta blocker drops two times a day. During the study, IOP was treated only by beta blocker and IOP had to be <20 mmHg, measured at the time of the first visual field examination and at the following examinations. Eleven patients were excluded because IOP under therapy was not under 21 mmHg at the first visit or in the following controls.
At the time of the first visual field, the glaucoma disease had been in evidence for an average of 4.7 years (±3.7) and in all the patients the IOP, under therapy, remained stable for the duration of the study (average 16.9 mmHg ± 2.3).
All the included patients were divided into four subgroups, relating to refractive error. The first subgroup included patients with refraction between +2.00 D and +4.00 D, the second between +1.75 D and –1.75 D, the third between –2.00 D and –7.50 D, and the fourth between –8 D and –14.00 D (Tab. I).
The visual field of all the included patients was assessed by an Octopus 30° central visual field every 6 months, for

TABLE I - DESCRIPTIVE ANALYSIS

	Group 1	Group 2	Group 3	Group 4
Diopters	+8 to +2	+1.75 to –1.75	–2 to –7.5	–7.75 to –25
Age, yr	64±7.23	56.1±16.8	58.5±15.2	51.2±12.8
No. eyes	30	75	53	50
IOP, mmHg (under therapy)	17.3±1.7	17.2±3.1	16.6±1.8	16.8±1.8
Time of disease, yr	4.2±2.9	4.6±3.4	4.4±4	5.3±4
Corrected visual acuity	0.99±0.4	0.96±0.13	0.84±0.27	0.7±0.3

Values are mean ± SD

a total of 837 visual fields examined. The duration of the study ranged from 24 to 64 months and for each eye examined, the number of visual fields analyzed ranged from 4 to 11.
The resulting data were analyzed by PERIDATA for Windows 1.7 TREND function (linear regression analysis of perimetric indexes vs time). These results were in turn processed using Macintosh Statview II program analysis of variance.

RESULTS

At the first examination, 82% of eyes showed a global decrease of relative differential light sensitivity (MD >2 dB) and in 67% the distribution of the defect was nonhomogeneous (LV >6 dB).
The analysis of variance for subgroups showed a significant decrease of MD in highly myopic patients. The age of this subgroup was significantly younger, furthermore a difference of 13 years was found between highly myopic and hyperopic subgroups. Therefore it could be assumed that glaucoma disease has an earlier onset in highly myopic eyes (11). Among the four subgroups there was no significant difference for time of disease and mean IOP, confirming the homogeneity of comparison among the subgroups. A linear regression analysis (PERIDATA) highlighted a statistically significant change in time of MD in 36% and of LV in 34% of the eyes studied. An analysis for subgroups showed that highly myopic patients had the highest ($p<0.005$) percentage of change of MD and LV (46% and 42%, respectively).

DISCUSSION

Among the different methods of diagnosis and follow-up for glaucoma, examination of the visual field is one of the most important and the advent of computerized perimetry has offered more opportunities for studying the progression of visual field loss (12, 13).
These results showed that after 5 years of glaucoma, the visual field was altered in most of the eyes examined (82%) and that in 67% of cases, its defect is nonhomogeneous and worsened with the increase of myopia, a phenomenon already referred to by others (14, 15). The regression linear analysis of visual field changes in time showed a progressive increase of MD and of LV in approximately one third of all the eyes examined. This percentage goes up to nearly 50% for MD in highly myopic eyes. In spite of refraction and of its influence in the progression of damage, the visual field decay in myopic glaucomatous eyes is confirmed by the significant worsening of LV in time (42% in highly myopic eyes). This result is also more interesting in patients with high myopia, considering that the mean IOP was always <20 mmHg for the entire duration of the study.
Therefore, ganglion cells of highly myopic glaucomatous eyes seem to be more vulnerable than normal eyes and a lower value of IOP must be pursued to avoid the progression of the disease in time. The decay of visual field at different degrees of myopia in glaucomatous patients where the target pressure is achieved could be due to ocular blood flow and microcirculation changes (16, 17), confirming those as one of the causes of glaucomatous optic neuropathy.
At the time of the study corneal pachymetry was not taken. It is our intention to review these data in relation to corneal depth as it was recently demonstrated to be one of the major risk factors of progression in hypertensive and glaucomatous eyes (18).
The recent knowledge of the importance of cornea thickness in determining accurate IOP values makes the boundary between the two diseases unclear. High tension glaucoma could have POAG diagnosed because of a thick cornea, while normal tension glaucoma could be defined as POAG due to a thin cornea. Clinically, even if corneal thickness could be assessed in most of the patients, it has been suggested by the European Glaucoma Society that corneal thickness should be determined in POAG or ocular hypertension only when findings do not match. This is a retrospective study and for this reason we do not have corneal thickness among the data. However, the target pressure after treatment reached by the two subgroups was statistically different.

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