

EFFECT OF CATARACT EXTRACTION ON VISUAL FIELD IN PATIENTS WITH OPEN ANGLE GLAUCOMA

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SUMMARY – The aim of the study was to retrospectively analyze changes in the results of automated perimetry in open angle glaucoma patients, including Mean Defect (MD), Loss Variance (LV) and Corrected Loss Variance (CLV) before and after cataract surgery, and also to note how the presence of dense scotoma preoperatively could influence postoperative results. MD is a mean of all local visual field defects. LV and CLV are indexes of localized field damages. Increased values of these indicators are even more specific for glaucomatous damage than MD. We investigated 18 eyes of 14 patients with open angle glaucoma who were scheduled for cataract extraction with intraocular lens implantation. The diagnosis of open angle glaucoma was based on the presence of glaucomatous optic disk cupping and abnormal results on glaucoma field testing. The intraocular pressure (IOP) criterion was IOP higher than 21 mm Hg. On gonioscopy, all angles of the anterior chamber were open. All patients underwent Octopus Field Analyzer dG2 testing within two months before and three months after cataract surgery. The eyes were divided into two groups based on the presence of absolute or near absolute (dense) scotomata before surgery. Dense (absolute or near absolute) scotomata noted on automated perimetry were found not to be caused by the cataract. Their existence before surgery could be explained by glaucomatous visual field defects. Cataract can induce various degrees of relative scotoma, which can induce worsening of local field defects (LV and CLV) after surgery. This implies that the real size of glaucomatous damage (expressed as difference between LV and CLV before and after cataract surgery) can only be seen and properly measured after cataract extraction. Therefore, it is concluded that LV and CLV can be used as reliable indicators in distinguishing the role of coexisting cataract in glaucomatous damage, however, additional studies in the area are needed.

Key words: *cataract extraction, glaucoma visual field damage, dense scotoma, automated perimetry*

Introduction

Open angle glaucoma is a chronic progressive multifactorial optic neuropathy, which is diagnosed if the following criteria are met: intraocular pressure (IOP) greater than 21 mm Hg without treatment, characteristic glaucomatous damage to the optic disk (cup/disk ratio more than 0.4), and visual field defects that correspond to optic disk damage¹. On gonioscopy, we found that all anterior chamber angles were open. Automated perim-

etry is the essential method for detecting and long-term follow up of patients with glaucoma. It detects early glaucomatous visual field defects more accurately than normal perimetry^{2,3}.

The Octopus Field Analyzer (dG2 program) is a software intended for evaluation of glaucoma field defects. It calculates global indexes of MD, LV and CLV. Mean Defect (MD) is the mean of all local defects of visual field. MD is the most important index related to global damage of visual field. A trend in visual field change can be best analyzed by following MD changes. Loss Variance (LV) and Corrected Loss Variance (CLV) are indexes of local field damages. LV is a measure of focal loss or variability within the field, taking into account

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any generalized depression in the hill of vision. An increased LV is a more sensitive indicator of glaucomatous damage than MD. Therefore, LV index is sensitive for irregularity and is an early indicator of localized damage. CLV is also designed for detection of localized damage and measures variability within the field after correction for short-term fluctuation (intra-test variability). This results in even more sensitive detection than LV of early local field defects. However, when cataract develops in glaucoma patients, distinguishing the role of either condition by use of automated perimetry results poses a challenge for clinicians. A study of the effect of cataract on automated perimetry results has generally shown that cataract causes diffuse reduction of sensitivity on automated perimetry^{4,7}, while changes in localized indexes are reported to be nonsignificant^{4,6,8,9}. Only one retrospective study by Smith *et al.* demonstrated that one of the localized defect indexes worsened in many subjects with dense scotomata, suggesting that a cataract can mask the progressive visual field loss in such patients.

The aim of our study was to retrospectively investigate changes in the results of automated perimetry, including MD, LV and LCV before and after cataract surgery, and also to assess the impact of preoperative presence of dense scotomata on postoperative results.

Patients and Methods

This study was of a retrospective case series design. We investigated 18 eyes of 14 patients with open angle glaucoma who were scheduled for cataract extraction with intraocular lens (IOL) implantation. Diagnostic criteria for open angle glaucoma have been previously described. The diagnosis of open angle glaucoma was based on the presence of glaucomatous optic disk cupping and abnormal results on glaucoma field testing. The intraocular pressure (IOP) criterion was IOP higher than 21 mm Hg. On gonioscopy, all angles of the anterior chamber were found to be open.

All patients underwent Octopus Field Analyzer dG2 testing within two months before and three months after cataract surgery. The eyes were divided into two groups based on the presence of absolute or near absolute (dense) scotomata before surgery. Exclusion criteria were as follows: ocular hypertension, secondary glaucoma, prior ocular surgery, prior ocular inflammation, and any retinal or neuro-ophthalmologic pathology that would produce visual field loss.

Table 1. Demographic and clinical characteristics of study patients

Characteristic	n
Number of patients	14
Sex: female	10
male	4
Mean (\pm SD) age (yrs)	67.4 \pm 8.6
Number of eyes	18
Mean short-term fluctuation (\pm SD):	
preoperative	1.68 \pm 0.66 dB
postoperative	1.66 \pm 0.66 dB

All surgeries were performed by one surgeon and all patients underwent phacoemulsification cataract extraction with IOL implantation. Changes in visual acuity, IOP, number of absolute scotomata, MD, LV and CLV were analyzed. Differences between preoperative and postoperative results were evaluated by Wilcoxon test.

Results

Eighteen eyes of 14 subjects were included in the analysis. Patient demographic and clinical characteristics are shown in Table 1. The mean age of study patients (\pm SD) was 67.4 \pm 8.6 years; there were ten women and four men. The mean short-term fluctuation (\pm SD) was 1.68 \pm 0.66 dB before and 1.66 \pm 0.66 dB after surgery. Changes in the mean visual acuity, IOP and number of medications for all study patients are shown in Table 2. The mean visual acuity worsened ($p < 0.0001$), the mean IOP decreased significantly ($p < 0.0001$), and the number of medications was reduced ($p < 0.0001$) after surgery. Table 3 shows changes in the number of dense scotomata, mean number of dense scotomata, and mean number of central dense scotomata. Dense scotomata were present in 14 of 18 eyes

Table 2. Changes in mean visual acuity, intraocular pressure and number of medications in study patients

	Preoperative	Postoperative	<i>p</i>
Visual acuity	0.24 \pm 0.21	0.76 \pm 0.39	<0.0001*
Intraocular pressure	19.20 \pm 5.70	14.5 \pm 4.30	<0.0001*
Number of medications	1.32 \pm 1.17	0.51 \pm 0.80	<0.0001*

*Wilcoxon test

Table 3. Changes in number of dense scotomata, mean number of dense scotomata and mean number of central dense scotomata

	Preoperative	Postoperative	<i>p</i>
Dense scotomata			
Number of eyes (%)	14 (77.8%)	13 (72.2%)	0.6245*
Mean (\pm SD) number	22.70 \pm 23.90	21.30 \pm 23.1	0.6603*
Central dense scotomata			
Mean (\pm SD) number	0.88 \pm 1.28	0.71 \pm 1.22	0.3453*

*Wilcoxon test

(77.8%) preoperatively and in 13 of 18 eyes (72.2%) postoperatively, indicating that the finding of dense scotomata observed on preoperative automated perimetry was false-positive in only one patient. Furthermore, the mean number of dense scotomata and central dense scotomata before and after surgery was similar. Table 4 shows changes in MD, LV and CLV in the two patient groups with and without dense scotomata on preoperative and postoperative Octopus threshold test. In the group with dense scotomata, LV and CLV worsened significantly after surgery ($p < 0.0001$), whereas MD improved significantly ($p < 0.0001$). However, in the group without dense scotomata, LV and CLV showed slight, statistically nonsignificant improvement, whereas MD showed significant improvement.

Discussion

When having a glaucomatous patient with or without field defects, scheduled for cataract extraction, it is

important to separate visual field loss caused by cataract from actual field defects caused by glaucoma. Many studies report that cataract can cause diffuse loss of retinal sensitivity^{4,7}, but does not produce changes in the pattern of glaucomatous field defects^{4,6,8,9}. Only the study by Smith *et al.*¹⁰ recorded worsening in local visual field defects (CPSD obtained on Humphrey Field Analyzer correlated with CLV on Octopus Field Analyzer). Several previous studies of the effect of cataract extraction on automated perimetry have shown general improvement of retinal sensitivity in normal eyes^{11,12} and in glaucomatous eyes with¹¹ and without⁴ visual field loss. In the present study, we assessed the possible impact of the presence of dense scotomata before cataract surgery on the results of automated perimetry after surgery. The number of dense and central dense scotomata was similar before and after cataract surgery. This implies that a dense scotoma seen on automated perimetry is not usually caused by cataract, although cataract can produce various degrees of relative scotoma. When interpreting the number of dense scotomata before and after cataract surgery, we can conclude that dense scotoma is the result of actual glaucoma. In the group of patients with dense scotoma before surgery, LV and CLV worsened significantly, while MD improved. As shown in Table 3, the number of dense scotomata did not change after surgery, whereas relative scotomata decreased (in Table 4 expressed as a significant change in LV and CLV). These changes produced asymmetry in visual field, which had an impact on local visual field defects and made them worse after surgery, implying that cataract can mask the loss of sensitivity caused by glaucoma. On the other hand, in the group of patients without dense scotomata, LV and CLV showed slight

Table 4. Changes in Mean Defect (MD), Loss Variance (LV) and Corrected Loss Variance (CLV) in two patient groups with and without dense scotomata on preoperative and postoperative Octopus threshold test

	Preoperative	Postoperative	Mean change	<i>p</i>
With dense scotomata				
MD	14.4 \pm 6.41	11.82 \pm 8.93	2.68	<0.0001*
LV	7.47 \pm 2.96	8.76 \pm 3.35	1.28	<0.0001*
CLV	6.86 \pm 3.18	8.13 \pm 3.60	1.28	<0.0001*
Without dense scotomata				
MD	6.59 \pm 3.58	2.56 \pm 2.55	4.03	<0.0001*
LV	4.08 \pm 2.42	3.68 \pm 3.10	0.40	0.4434 [†]
CLV	4.39 \pm 2.67	3.98 \pm 2.13	0.41	0.4476 [†]

*Wilcoxon test

improvement. As shown in Table 4, relative scotomata caused by cataract decreased substantially after cataract extraction and visual field results in these patients could be considered as being within the normal limits. Post-operative visual acuity was significantly improved, which could be a consequence of lens extraction. The IOP and number of antiglaucoma medications decreased significantly, although visual field changes were the result of cataract extraction.

In conclusion, the dense (absolute or near absolute) scotomata recorded on automated perimetry were not caused by cataract. Their existence before surgery could be explained by glaucomatous visual field defects, as confirmed by the nearly same number of dense scotomata after surgery. Cataract can induce various degrees of relative scotoma and can mask, to some extent, the size of glaucomatous damage, which can be measured as difference in LV and CLV values before and after cataract surgery. Therefore, LV and CLV can be used as reliable indicators in glaucoma patients with dense scotomata and coexisting cataract, however, additional studies in the area are needed.

References

1. STONE EM, FINGERT JH, ALWARD JH *et al.* Identification of a gene that causes POAG. *Science* 1997;275(5300):668-70.
2. HEIJI A, DRANCE SM. A clinical comparison of three computerized automatic perimeters in the detection of glaucoma defects. *Arch Ophthalmol* 1981;99:832-6.
3. HOTCHKISS ML, ROBIN AL, QUIGLEY HA, POLLACK IP. A comparison of Peritest automated perimetry and Goldmann perimetry. *Arch Ophthalmol* 1985;103:397-403.
4. GUTHAUSER U, FLAMMER J. Quantifying visual field damage caused by cataract. *Am J Ophthalmol* 1988;106:480-4.
5. WOOD JM, WILD JM, SMERDON DL, CREWS SJ. Alterations in the shape of the automated perimetric profile arising from cataract. *Graefes Arch Clin Exp Ophthalmol* 1989;27:157-61.
6. LAM BL, ALWARD WLM, KOLDER HE. Effect of cataract on automated perimetry. *Ophthalmology* 1991;98:1066-70.
7. HEUER DK, ANDERSON DR, KNIGHTON RW, FEUER WJ, GRESSEL MG. The influence of simulated light scattering on automated perimetric threshold measurements. *Arch Ophthalmol* 1988;106:1247-51.
8. BUDENTZ DL, FEUER WJ, ANDERSON DR. The effect of simulated cataract on the glaucomatous visual field. *Ophthalmology* 1993;100:511-7.
9. STEWART WC, ROGERS GM, CRINKLEY CMC, CARLSON AN. Effect of cataract extraction on automated fields in chronic open angle glaucoma. *Arch Ophthalmol* 1997;115:1515-9.
10. SMITH SD, KATZ J, QUIGLEY HA. Effect of cataract extraction on the results of automated perimetry. *Arch Ophthalmol* 1995;115:1515-9.
11. HEIDER HW, SEEZ KJ, SCHNAUDIGEL OE. Gesichtsfeldveränderungen durch Linsentrübungen. *Klin Monatsbl Augenheilkd* 1991;198:15-9. (English abstract)
12. YAO K, FLAMMER J. Relationship between cataract density and visual field damage. *Eur J Ophthalmol* 1993;3:1-5.

Sažetak

UČINAK EKSTRAKCIJE KATARAKTE NA VIDNO POLJE BOLESNIKA S GLAUKOMOM OTVORENOG KUTA

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Cilj ove studije bio je retrospektivno istražiti promjene u rezultatima kompjutorizirane automatske perimetrije bolesnika s glaukomom otvorenog kuta, uključujući pokazatelje glaukomske oštećenja: MD (*Mean Defect*), LV (*Loss Variance*) i CLV (*Corrected Loss Variance*) prije i poslije operacije katarakte te ocijeniti kako prisutnost apsolutnog skotoma preoperacijski utječe na poslijeoperacijske rezultate. MD je prosječna vrijednost svih lokalnih oštećenja vidnog polja, dok su LV i CLV pokazatelji lokalnog oštećenja vidnog polja. Povišene vrijednosti ovih pokazatelja još specifičnije ukazuju na glaukomsko oštećenje u odnosu na vrijednosti MD. Ispitali smo 18 očiju u 14 bolesnika s glaukomom otvorenog kuta koji su bili predviđeni za ekstrakciju katarakte s implantacijom intraokularne leće. Dijagnoza glaukoma je bila postavljena na osnovi kliničkog nalaza ekskavacije glave vidnog živca i patološkim nalazom vidnog polja. Intraokularni tlak je morao biti veći od 21 mm Hg te gonioskopski utvrđen otvoren kut prednje očne sobice. Svi bolesnici su testirani pomoću kompjutoriziranog perimetra Octopus, program dG2, dva mjeseca prije i tri mjeseca poslije operacije katarakte. Oči su podijeljene u dvije skupine prema prisutnosti apsolutnog skotoma prije operacije. Utvrđeno je kako apsolutni skotom, potvrđen kompjutoriziranom perimetrijom prije operacije, nije uzrokovan kataraktom te da je posljedica stvarnog glaukomske oštećenja. U skupini bolesnika s apsolutnim skotomom pokazatelji lokalnog oštećenja vidnog polja (LV i CLV) pogoršali su se poslijeoperacijski, što ukazuje na to da se uklanjanjem relativnih skotoma uzrokovanih kataraktom dobiva stvarna veličina glaukomske oštećenja koje može donekle biti skriveno kataraktom (izraženo u razlici vrijednosti parametara LV i CLV prije i poslije operacije katarakte). Stoga se zaključuje da LV i CLV mogu biti pouzdani pokazatelji u razlikovanju oštećenja vidnog polja uzrokovanih glaukomom i pratećom kataraktom, no potrebne su daljnje studije u tom smjeru.

Ključne riječi: *ekstrakcija katarakte, glaukomska oštećenja vidnog polja, apsolutni skotom, kompjutorizirana perimetrija*

