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Effect of cataract surgery and foldable intraocular lens implantation on retinal nerve fiber layer as measured by scanning laser polarimetry with variable corneal compensator

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PURPOSE. *Scanning laser polarimetry (SLP) enables the measurement of retinal nerve fiber layer (RNFL) thickness* in vivo. *As SLP measurements can be influenced by several conditions such as corneal birefringence, the new version GDx Access is implemented by the variable corneal compensator (VCC). The aim of this study was to evaluate the influence of cataract extraction and foldable intraocular lens (IOL) implantation on SLP parameters measured by GDx Access.*

METHODS. *Sixty-eight eyes of 68 patients undergoing phacoemulsification with foldable IOL implantation (silicone and acrylic) were examined by SLP before and after surgery. SLP was performed using GDx Access (with VCC). Mean values for SLP parameters were compared before and after 30 days from surgery with paired two-tailed Student's t-test.*

RESULTS. *No statistically significant differences were found between SLP parameters before and after cataract surgery, and regardless of the type of IOL implanted.*

CONCLUSIONS. *Phacoemulsification and foldable IOL implantation do not influence RNFL parameters, as measured by GDx Access. (Eur J Ophthalmol 2004; 14: 106-10)*

KEY WORDS. *Foldable IOL, Phacoemulsification, Scanning laser polarimetry, Variable corneal compensator*

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INTRODUCTION

Scanning laser polarimetry (SLP) has been demonstrated to measure retinal nerve fiber layer (RNFL) thickness *in vivo* (1, 2). The technique utilizes a polarized laser light of 780 nm that penetrates the RNFL and is partially reflected back toward the instrument from the deeper retinal layers. Due to the presence of parallel intracellular microtubules within the ganglion cell axons, the RNFL has form-birefringent properties, and subsequently causes a change in the state of polarization of the laser light. This change, known as retardation, is related to RNFL thickness and is measured consecutively at each of 65,536 (256 × 256) pixels in the field of view. As other tissues in the eye, particularly the cornea, exhibit form-birefringent properties, the instrument has an integrated element that compensates for corneal birefringence; this device assumes that all individuals have a fixed corneal polarization axis of 15 degrees nasally downward (3).

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SLP has been shown to provide good differentiation between normal and glaucomatous eyes, and to correlate moderately with visual field loss in groups of eyes with primary open-angle glaucoma (POAG) (4-7). In addition, SLP has demonstrated a decrease in RNFL thickness with age in a given population and in ocular hypertensive eyes, when compared with normal eyes (8). The instrument (GDx Access, Laser Diagnostic Technologies, San Diego, CA) also includes modulation parameters that are thought to achieve better discrimination between normal and glaucomatous eyes (9-12).

The reliability of SLP can be compromised by several factors, such as corneal birefringence (13) (this problem has been solved by the new version of GDx, which includes the variable corneal compensator [VCC]), diabetic retinopathy (14), panretinal photocoagulation, optic neuritis and PRK (15). Cataract extraction and acrylic intraocular lens (IOL) implantation have also been shown to influence SLP measurements; an increase in total band circumference, and in RNFL thickness in superior, inferior, and nasal quadrants, has been found (16).

The aim of the current study was to determine the influence of cataract surgery and foldable IOL implantation on each of the RNFL parameters, as measured by GDx Access.

METHODS

Between September and November 2002, 80 consecutive patients were enrolled from the Cataract Surgery Service of the Department of Ophthalmology of the University of Bari. All patients underwent thorough ophthalmologic examination, including best-corrected visual acuity (BCVA) measurement, Goldmann applanation tonometry, slit-lamp biomicroscopy, and fundus examination after pupil dilation. Cataracts were graded using the Lens Opacities Classification System III (17). In addition, automated perimetry was performed with the Humphrey Field Analyzer II 30-2 program (Humphrey Systems, Dublin, CA) using full threshold strategy, and SLP was carried out using GDx Access.

Following selection of patients, six eyes were excluded due to poor image quality (resulting from poor patient cooperation and/or dense nuclear cataract), four eyes were excluded following discovery of optic disc anomalies, and two eyes were excluded due to the presence of glaucomatous optic nerve neuropathy.

SLP was performed before and after 30 days after surgery. Image quality was at least 9, as reported by GDx software. All RNFL measurements were performed by the same examiner (T.T.), who is experienced in the field.

After randomized assignment to either acrylic or silicone IOL, all patients underwent uncomplicated phacoemulsification with IOL placement in the capsular bag by means of a temporal clear corneal approach: 44 eyes received a silicone IOL (SI40, Allergan Inc, Irvine, CA) and 24 eyes received an acrylic IOL (AcrySof MA60BM, Alcon, Forth Worth, TX). The following RNFL parameters were measured: number, symmetry, superior ratio, inferior ratio, superior/nasal, max modulation, TSNIT average, ellipse modulation, ellipse average, and inferior average. The mean values of each parameter were compared between subgroups with paired two-tailed Student's t-test with Welch correction, using GraphPad InStat (GraphPad Software Inc, San Diego, CA). Values of $p<0.05$ were considered significant.

RESULTS

Sixty-eight patients, 24 male and 44 female, with mean age of 73.2±6.3 years were enrolled. Automated perimetry was normal in all patients, apart from a reduction in central sensitivity due to the presence of cataract. Nuclear and non-nuclear cataract was found in 36 and 32 patients, respectively. The mean BCVA was 20/63 preoperatively, and 20/20 postoperatively. Neither posterior capsular opacity nor postoperative intraocular pressure (IOP) spikes >25 mmHg were observed at the time of SLP imaging.

No significant differences were observed between any of the SLP parameters in the silicone and in the acrylic IOL groups (Tabs. I and II).

DISCUSSION

This study showed no significant differences between any of the SLP parameters after phacoemulsification with foldable IOL placement in the capsular bag, and

TABLE I - MEAN VALUES OF PREOPERATIVE AND POSTOPERATIVE SCANNING LASER POLARIMETRY PARAMETERS: ACRYLIC INTRAOCULAR LENS GROUP

Parameter	Preoperative mean value	Postoperative mean value
Symmetry	0.87±0.32	1±0.33
Superior ratio	2.03±0.92	1.94±0.75
Inferior ratio	2.03±0.74	2.1±0.92
Superior/nasal	1.47±0.44	1.64±0.31
Max modulation	1.16±0.84	1.36±0.95
Ellipse modulation	1.73±0.6	2.09±0.45
The number	36.33±23.72	34.16±22.76
TSNIT average	68.33±7.99	72±13.62
Ellipse average	71.5±8.16	78.33±12.17
Superior average	72.5±11.64	80±13.63
Inferior average	81.83±17.44	90.16±24.19

p Values were not significant

TABLE II - MEAN VALUES OF PREOPERATIVE AND POSTOPERATIVE SCANNING LASER POLARIMETRY PARAMETERS: SILICONE INTRAOCULAR LENS GROUP

Parameter	Preoperative mean value	Postoperative mean value
Symmetry	0.98±0.07	0.97±0.09
Superior ratio	2.01±0.48	2.04±0.48
Inferior ratio	2.05±0.39	2.11±0.44
Superior/nasal	1.85±0.29	1.9±0.29
Max modulation	1.14±0.34	1.19±0.41
Ellipse modulation	1.97±0.43	2.04±0.69
The number	24.81±17.86	27.81±23.6
TSNIT average	63.03±10.98	65.09±14.41
Ellipse average	66.72±10.46	69.27±14.78
Superior average	71.18±12.32	75.36±15.23
Inferior average	78.27±11.79	82±20.74

p Values were not significant

regardless of the type of IOL (silicone or acrylic) implanted. Our results are slightly different from other similar studies. The study performed by Kremmer et al (18) showed significant differences before and after phacoemulsification with implantation of two types of IOL: PMMA-IOL, Pharmacia & Upjohn, model 811B (parameters: superior average, superior/nasal, the number, average thickness), and HEMA/MMA-IOL, Technomed, Memory Lens (parameters: inferior average, the number). The study by Park et al (16) showed significant differences before and after phacoemulsification with acrylic IOL implantation (AcrySof MA60BM) for the parameters total band circumference and superior, inferior, and nasal quadrants whereas no differences were found for silicone (Chiron L161U, Bausch and Lomb, Claremont, CA) and PMMA (various manufacturers). This study did not measure standard SLP parameters but developed original parameters, such as total band circumference and superior, inferior, nasal, and temporal quadrants. In addition, this study en-

rolled a small number of eyes (acrylic IOL group, 11; silicone IOL group, 15; PMMA IOL group, 8). Moreover, both studies were performed using the first version of GDx, which did not have the VCC.

The current study suggests that there are no differences detectable between SLP parameters using the new version of GDx. The different outcome with respect to the other studies may be explained considering that the other authors found little variations, often regarding only some parameters and/or some types of IOL. In addition, none of them used the new version of GDx; therefore it is possible that the previous version of the instrument biased the outcomes.

In conclusion, it is likely that cataract surgery and foldable IOL implantation have no influence on SLP measurements, or that such influences are not different from those occurring due to the pre-existing cataract.

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