

# Anterior segment optical coherence tomography for evaluation of changes in anterior chamber angle and depth after intraocular lens implantation in eyes with glaucoma

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**PURPOSE.** To examine anterior chamber depth (ACD) and anterior chamber angle (ACA) in patients with glaucoma after cataract extraction with an anterior optical coherence tomography (OCT) system.

**METHODS.** A new commercially available 1310 nm infrared light anterior segment OCT system was used for anterior chamber evaluation. Sixty patients ( $n=20$  with primary open angle glaucoma [POAG],  $n=20$  with angle closure glaucoma [ACG], and  $n=20$  with no known glaucoma as control group) with a mean age of  $68.8 \pm 13.9$  years undergoing cataract surgery were enrolled.

**RESULTS.** Before cataract surgery, ACD and ACA of the ACG group were significantly lower compared to the POAG and control groups (ACD  $p < 0.005$ ; ACA  $p < 0.005$ ). After cataract extraction, ACD and ACA increased significantly in the ACG group ( $3.1 \pm 0.4$  mm vs  $1.8 \pm 0.2$  mm,  $p < 0.005$  and  $32.3^\circ \pm 7.7^\circ$  vs  $16.0^\circ \pm 4.7^\circ$ ,  $p < 0.005$ ). In the POAG and control groups, ACD and ACA also increased postoperatively, but not as much as in the ACG group. After cataract extraction, IOP decreased significantly in the glaucoma groups (ACG:  $15.6 \pm 6.1$  vs  $18.6 \pm 5.7$  mm Hg,  $p = 0.008$ ; POAG:  $16.2 \pm 3.4$  vs  $20.7 \pm 8.0$  mmHg,  $p = 0.02$ ) and was almost the same in all three groups after surgery (control group after surgery:  $15.2 \pm 2.8$  mmHg).

**CONCLUSIONS.** Both ACD and ACA increased significantly after cataract extraction and IOL implantation. IOP reduction after surgery was higher in the glaucoma groups compared to the control group. (*Eur J Ophthalmol* 2007; 17: 363-7)

**KEY WORDS.** Anterior segment OCT, Anterior chamber angle, Anterior chamber depth, Cataract, Glaucoma

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## INTRODUCTION

Noncontact anterior optical coherence tomography (OCT) is a new method for anterior chamber evaluation. Some reports using a slit lamp adapted system or prototypes of a high-speed anterior segment OCT have been published (1-6). For this study a new commercially available anterior chamber OCT was used. The first pilot studies show a high reproducibility of the method both for biometric

analysis as well as for anterior chamber dynamics (7, 8). This study aimed to investigate changes of the anterior chamber depth (ACD) and anterior chamber angle (ACA) in patients with different forms of glaucoma after lens extraction. Actual studies implicate an excellent visualization of anterior chamber dynamics by using anterior segment OCT (3, 4). In direct comparison to ultrasound biomicroscopy, anterior segment OCT was favorable in detecting narrow anterior chamber angles (4). Our study com-

pares for the first time anterior chamber dynamics of eyes with glaucoma after cataract extraction in comparison to eyes without glaucoma with the help of the new Visante® anterior segment OCT.

## MATERIALS AND METHODS

All investigations were performed according to the tenets of the Declaration of Helsinki and with approval by the local ethical committee. All subjects gave their informed consent for their inclusion in the study. Anterior chamber evaluation was performed by a new commercially available anterior segment OCT with a wavelength of 1310 nm (Visante™ OCT, Carl-Zeiss Meditec Jena, Germany).

For all measurements the pupil was undilated and standardized lighting conditions were used. For this study the 3 o'clock and 9 o'clock meridian were taken by the 4 quad, high resolution setting. Preoperative ACD was taken from endothelium to the anterior lens surface, postoperative ACD was taken from the endothelium to the posterior iris plane by central measurements. The center of corneal curvature was automatically given by the system, after determination of the internal width of the anterior chamber by setting of measurement points at the corresponding anterior chamber recesses. The ACA was defined as the arms of the posterior surface of the cornea and the opposite iris. The apex was in the angle recess.

Intraocular pressure (IOP) was measured 1 day prior to and 1 day after cataract surgery by a masked investigator. Sixty patients undergoing cataract surgery (mean age 68.8±13.9 years; 22 male and 38 female patients) were included in this prospective study. According to their underlying disease subjects were divided into primary open angle glaucoma (POAG; n=20), angle closure glaucoma (ACG; n=20), and a control group with no known glaucoma (n=20). Subject characteristics are shown in Table I. In all patients an exact pre- and postoperative investigation including anterior segment OCT was performed.

Statistics were assessed by the Mann-Whitney test with a selected significance level of 0.05. Results are shown in median, minimum, and maximum.

## RESULTS

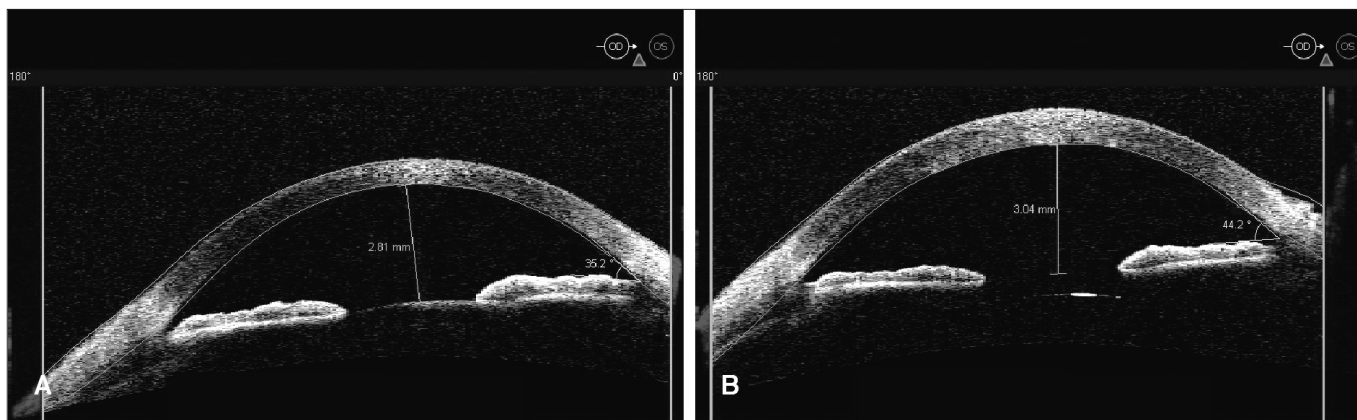
In all subjects an OCT image of the anterior chamber and an evaluation of ACD and ACA could be performed. Before surgery ACD and ACA were significantly lower in patients with ACG compared to POAG and control group (ACD: 1.8±0.2 mm vs 2.8±0.5 mm and 2.5±0.3 mm, p<0.005; ACA: 16.0°±4.7° vs 39.5°±7.5° and 32.0°±8.3°, p<0.005). Furthermore, lens thickness in ACG group was significantly greater compared to control group (5.2 mm vs 4.5 mm; p<0.005). Lens thickness in POAG patients was nearly similar to the control group (4.6 mm).

**TABLE I - SUBJECT CHARACTERISTICS**

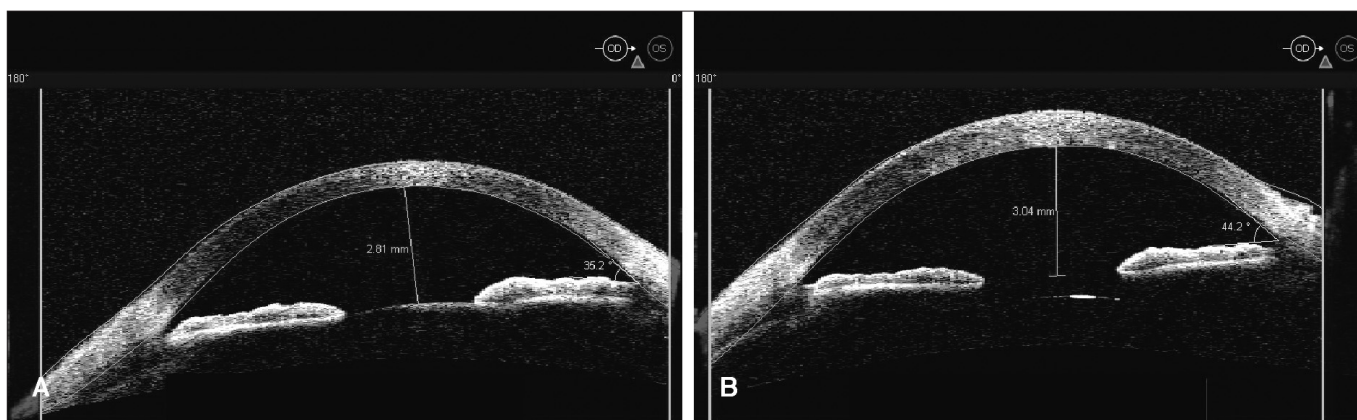
Diagnosis	Number of subjects (eyes)	Male patients	Female patients	Mean ± SD age, yr
Control group	20 (20)	11	9	74.1±11.0
Primary open angle glaucoma	20 (20)	5	15	66.6±16.8
Angle closure glaucoma	20 (20)	6	14	65.7±12.2

**TABLE II - PRE- AND POSTOPERATIVE ANTERIOR CHAMBER DEPTH (ACD) AND ANTERIOR CHAMBER ANGLE (ACA)**

Diagnosis	ACD (mm)			ACA ( ° )		
	Preop	Postop	p value	Preop	Postop	p Value
Control group	2.5±0.3	3.3±0.2	<0.005	32.0±8.3	38.8±5.7	<0.005
Primary open angle glaucoma	2.8±0.5	3.1±0.4	<0.005	39.5±7.5	41.2±7.5	0.035
Angle closure glaucoma	1.8±0.2	3.1±0.4	<0.005	16.0±4.7	32.3±7.7	<0.005



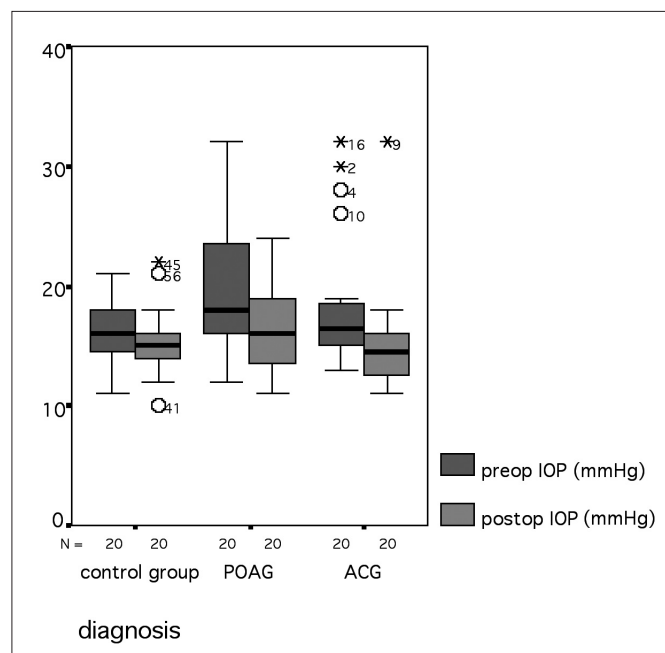
**Fig. 1** - 58-year-old woman, no known glaucoma. **(A)** Preoperative anterior segment optical coherence tomography (OCT) (lens thickness 4.2 mm, intraocular pressure [IOP] 18 mmHg); **(B)** postoperative anterior segment OCT (IOP 16 mmHg).



**Fig. 2** - 58-year-old woman with a 20-year history of primary open angle glaucoma. **(A)** Preoperative anterior segment optical coherence tomography (OCT) (lens thickness 4.8 mm, intraocular pressure [IOP] 20 mmHg); **(B)** postoperative anterior segment OCT (IOP 18 mmHg).



**Fig. 3** - 69-year-old woman with a 16-year history of angle closure glaucoma. **(A)** Preoperative anterior segment optical coherence tomography (OCT) (lens thickness 5.2 mm, intraocular pressure [IOP] 19 mmHg); **(B)** postoperative anterior segment OCT (IOP 15 mmHg).



**Fig. 4** - Significant intraocular pressure (IOP) reduction after cataract extraction in primary open angle glaucoma group ( $p=0.02$ ) and ACG group ( $p=0.008$ ) compared to slight IOP reduction in control group (not significant).

Peripheral anterior synechiae in ACG patients could be seen in anterior segment OCT in some patients. After cataract extraction ACD and ACA increased significantly in all three groups, with the most remarkable changes in the ACG group. Details are shown in Table II. In Figures 1–3, examples of pre- and postoperative anterior segment OCT evaluation of patients of each group are displayed. In all three groups no significant differences in ACD and ACA could be found between male and female patients at any time.

The mean preoperative IOP was  $18.6 \pm 5.7$  mmHg in the ACG group and  $20.7 \pm 8.0$  mmHg in the POAG group compared to  $16.2 \pm 6.3$  mmHg in the control group. After cataract extraction, however, IOP decreased significantly in the glaucoma groups (ACG:  $15.6 \pm 6.1$  mmHg,  $p=0.008$ ; POAG:  $16.2 \pm 3.4$  mmHg,  $p=0.02$ ) while the IOP decreased only minimally in the control group ( $15.2 \pm 2.8$  mmHg). Details are shown in Figure 4.

## DISCUSSION

The new anterior segment OCT offers an easy to handle, noncontact technique for anterior chamber evaluation. It was easy to use for elderly and handicapped patients.

Recent studies showed that ACD and chamber angle dynamics may be imaged and analyzed (5, 6). Cataract extraction is a well accepted procedure in patients with ACG (9-12). It is often more effective concerning IOP reduction than peripheral laser iridotomy (13). Evaluation of anterior chamber is an objective method for postoperative follow-up in these patients. In recent years, different methods for anterior chamber evaluation have been published (14, 15). Investigations using a Scheimpflug videophotography system also found significant changes of ACD and ACA in glaucoma patients as well as comparable results concerning IOP reduction (16). Our results strongly indicate a positive effect of cataract extraction especially in ACG patients by opening the ACA. Comparable results could be found in other studies (5, 10). POAG and control group patients also showed a significant increase of ACD and ACA. In comparison to other methods like ultrasound biomicroscopy and contact gonioscopy, anterior segment OCT is well tolerated in special situations like multiple local anesthetic allergies and phobia regarding conventional contact gonioscopy. Noncontact anterior segment OCT is a helpful method for objective pre- and postoperative anterior chamber evaluation and documentation in glaucoma patients.

*None of the authors has any financial or proprietary interest in any product or material mentioned in the text.*

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