Ultrasound Biomicroscopic Changes of the Eye after Cataract Surgery

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Abstract: Purpose: To evaluate the effect of cataract surgery and intraocular lens (IOL) implantation on the anterior segment anatomy of the eye in cataractous patients using ultrasound biomicroscopy (UBM). **Design:** Prospective, nonrandomized, comparative (self-controlled) trial. **Participants:** Twenty eyes of 20 patients with senile or pre-senile cataracts and no other ocular illness. Patients are classified into 2 groups according to the surgical technique; group 1(extracapsular cataract extraction, IOL implantation; 11 patients), and group 2(phacoemulsification, IOL implantation; 9 patients). **Methods:** Patients were examined with UBM before and 2 months after surgery. At each UBM examination, axial images of the anterior chamber, lens and radial sections of the angle, ciliary body were obtained. **Main Outcome Measures:** Angle opening distance at point 500 µm(AOD500), anterior chamber angle (ACA), central anterior chamber depth (ACD), iris thickness (ID), trabecular-ciliary process distance (TCPD), iris-lens contact distance (ILCD), sclera-ciliary body angle (SCA), iris-zonule distance (IZD), ciliary process-lens distance (CLD). **Results:** The variables ID, TCPD, SCA, IZD, and CLD in group 1 did not significantly change after surgery (P> 0.05). AOD500 significantly increased (P = 0.006), ACA significantly increased (P = 0.008), ACD significantly increased (P = 0.004), ILCD did not exist after surgery, except in 3 eyes (P = 0.028). No IOL optic tilt, the haptics were found to be in the capsular bag in 6 patients and in the sulcus in 5 patients. The variables AOD500, ID, TCPD, SCA, IZD, and CLD in group 2 did not significantly change after surgery (P> 0.05). ACA significantly increased (P = 0.015), ACD significantly increased (P = 0.011), ILCD did not exist after surgery, except in 2 eyes (P = 0.015). No IOL optic tilt, the haptics were found to be in the capsular bag in 8 patients and in the sulcus in 1 patient. **Conclusions:** After cataract surgery and IOL implantation, UBM revealed that the anterior chamber deepens and the angle widens. UBM provides quantitative values of angle parameters and may be of clinical significance in eyes with narrow angle or with occludable angles.
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Key words: ultrasound biomicroscopy, anterior chamber angle, Anterior eye segment, Cataract extraction, intraocular lens position.

1.Introduction

Cataract surgery and intraocular lens (IOL) implantation bring about clinically evident changes in the anterior segment configuration [(1)]. However, quantification of these changes is limited by conventional methods such as gonioscopy and ultrasonic biometry because of difficulties in evaluating dimensions of the anterior chamber [(2)].

High-frequency ultrasound biomicroscopy (UBM) allows high resolution, in vivo imaging of the anterior segment. The structures of the posterior chamber, previously hidden from clinical observation, can be assessed. The relationships between tissues and their architectures can be evaluated [(3)].

UBM can demonstrate structures behind the iris plane, which is a limitation of Scheimpflug camera devices and AS-OCT imaging [(1), (4)].

This study was designed to ascertain quantitatively, using UBM, the effects of cataract surgery (extracapsular cataract extraction (ECCE) with PCIOL implantation or phacoemulsification with foldable IOL implantation) on biometric determinants of angle configuration in vivo, as well as the anterior segment anatomy and the position of the IOL and their relationships to surrounding structures.

2. Patients and Methods

Twenty eyes of 20 patients participated in this study (men, 9 eyes of 9 patients; women 11 eyes of 11 patients); all patients aged 45-70 years; mean age ± standard deviation, , 59.9 ± 7.86 years). Our patients were selected from the outpatient ophthalmology clinics at Al Alzharaa university hospital. All have senile or pre-senile cataract due to Diabetes Mellitus (5 patients of 20 patients had diabetes mellitus). 11 eyes underwent ECCE and IOL implantation (group 1) and 9 eyes underwent phacoemulsification and foldable IOL implantation (group 2) from May 2011 through March 2012. All patients completed an ophthalmologic examination including best-corrected visual acuity, slit-lamp examination, Goldmann applanation tonometry, fundus examination (direct or indirect ophthalmoscopy), refractive power of cornea, axial length of eye, diopteric power of IOL calculation. Patients with any ocular abnormality other than senile cataracts and those who underwent previous ophthalmic surgery were not included.

The UBM was performed before and at least 2 months after surgery with the OTI scan 2000 (B/A scan ophthalmic ultrasound; OTI ophthalmic technologies Inc) which incorporates a 35/50-MHz transducer producing images with 50µm resolution and 8 mm penetration in the ocular tissues. The entire anterior segment is represented in a single image with an axial resolution. Examinations were performed under constant photopic illumination, with the patient in the supine position. Accommodation was kept constant by asking the patient to fixate on a small object held 1 meter from the fellow eye. After instillation of topical anesthesia, a rubberized immersion eye cup was inserted between the lids and was filled with 2% methylcellulose and saline solution for immersion, and held against the globe with just enough pressure to prevent leakage of fluid. The UBM section images were obtained axially and radially. The images obtained were stored as videos, images with the largest equatorial diameter were chosen using a slow- motion technique.

Using the calipers included in the equipment software, the following variables were measured:

The angle opening distance at 500µm (AOD500): the distance between the posterior corneal surface and the anterior iris surface measured on a line perpendicular to the trabecular meshwork at 500µm from the scleral spur (fig. 1).

The anterior chamber angle (ACA): measured with the apex at the scleral spur and the arms of the angle passing through the point on the meshwork 500µ from the scleral spur and the point on the iris perpendicularly opposite (fig. 2).

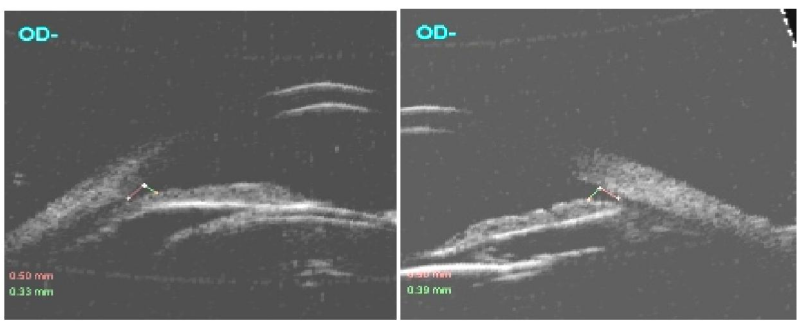

Fig. (1): AOD measured by UBM of the same eye (left) before and (right) 2 months after surgery.

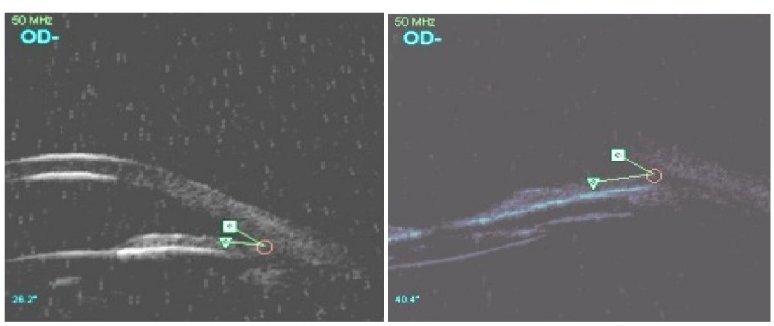

Fig. (2): ACA measured by UBM of the same eye (left) before and (right) 2 months after surgery. Note the change in iris configuration, widening the angle.

The anterior chamber depth (ACD): ACD at the center of the cornea measured by line extending between the posterior corneal surface and the anterior capsule or anterior IOL surface with attention to perpendicularity of the sound beam to the cornea and the lens interfaces (fig. 3).

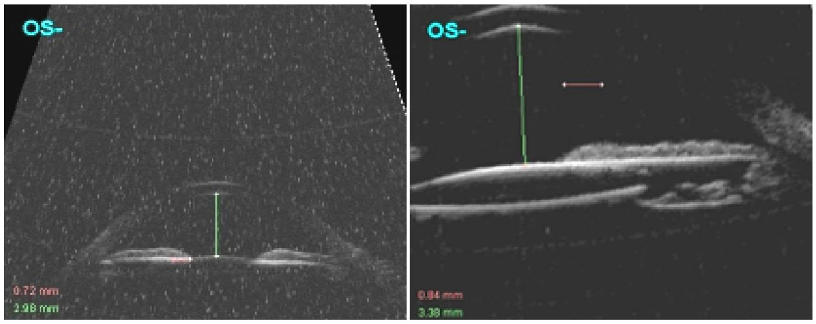

Fig. (3): ACD measured by UBM of the same eye (left) before and (right) 60 days after surgery.

The iris thickness (fig. 4)**:**

- **Iris thickness 1 (ID1):** the iris thickness measured along the same line as TCPD.
- **Iris thickness 2 (ID2):** the iris thickness measured 2mm from iris root.
- **Iris thickness 3 (ID3):** the iris thickness at its thickest point near the margin.

Trabecular ciliary process distance (TCPD): measured on a line from the corneal endothelium at 500µ from the scleral spur perpendicularly through the iris and extended to the ciliary process (fig. 5).

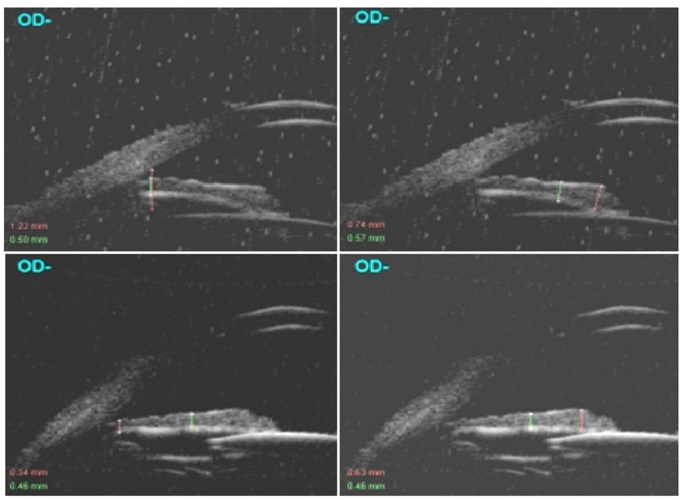

Fig. (4): ID1, ID2, ID3 measured by UBM of the same eye (top) before and (bottom) 60 days after surgery.

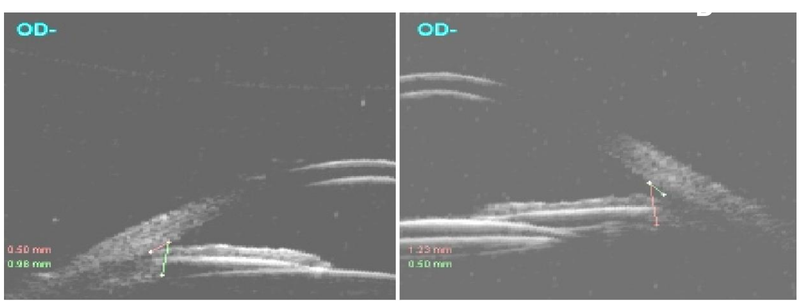

Fig. (5): TCPD measured by UBM of the same eye (left) before and (right) 2 months after surgery.

The iris-lens contact (ILCD): contact distance between the iris and the lens.

The scleral ciliary body angle (SCA): the arms of the angle passing through the ciliary process and the sclera.

The iris-zonule distance (IZD): distance between the iris and the zonule along the line of TCPD.

The ciliary process-lens distance (CLD): contact distance between the ciliary process and the lens.

Location of optic and haptic of IOL: defines its position in the capsular bag, ciliary sulcus, or a dislocated point.

Data were statistically described in terms of mean ± standard deviation (± SD). Comparison of numerical variables between the study groups was done using Mann Whitney U test for independent samples. Within group comparison of numerical variables was done using Wilcoxon signed rank test for paired (matched) samples. For comparing categorical data, Chi square (χ^2) test was performed. P values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

3. Results

The mean age of patients was 59.9 ± 7.86 years. Patient characteristics are listed in table 1.

Table 2 shows the parameters measured before and after cataract surgery and the change for each parameter after surgery of the two groups.

Angle opening distance 500µm from the scleral spur significantly increased after surgery in group1. The mean increase averaged approximately 151 µm, 40.8% more than that before surgery. No statistically significant difference was observed for the group2 between the pre and the postoperative measurements (table 2).

The anterior chamber angle opening was significantly increased after surgery in both groups compared with the preoperative measurements (table 2).

The anterior chamber was significantly deeper in both groups. The mean increase in ACD was 0.91mm, 32.5% deeper than before surgery (table 2).

Iris–lens contact distance significantly decreased after surgery (table 2). Contact between the iris and the IOL was observed in only five patients.

No statistically significant difference was observed for the both groups in ID_1, ID_2, ID_3, TCPD, SCA, IZD, and CLD between the pre and the postoperative measurements (table 2).

No IOL optic tilt in both groups. The haptics were found to be in the capsular bag in 14 patients (6 in group 1 and 8 in group 2) and in the sulcus in 6 patients (5 in group 1 and 1 in group 2).

4. Discussion

The aim of this study was to evaluate the effect of cataract and intraocular lens (IOL) implantation on the anterior segment anatomy in cataractous patients using high-frequency UBM.

The advantages of UBM technology are accuracy and reproducibility. High-resolution UBM provides precise measurements of the angle and makes it possible to analyze the anterior chamber quantitatively [5].

The present study comprised 20 eyes of 20 consecutive patients who underwent cataract surgery; ECCE and IOL implantation (group 1, 11 eyes) and phacoemulsification and foldable IOL implantation (group 2, 9 eyes). Comparing preoperative and postoperative measurements in both groups is summarized in table 2.

- Angle Opening Distance 500 (AOD500):

From this study we found that, the mean AOD500 on UBM is increased by 0.1155±0.11399mm, this signifies an increase by 29% from the preoperative mean value (Table 2). **Kurimoto et al.** [6] studied the effect of small-incision cataract surgery on anterior segment configuration using UBM and reported a backward movement of the iris diaphragm and a significant increase in angle opening in terms of AOD250, AOD500 after phacoemulsification. They also reported a significant correlation between preoperative and postoperative values: the narrower the angle, the greater the postoperative opening. Also **Pereira and Cronemberger** [1] observed in their study on 21 eyes with senile or presenile cataracts that the anterior chamber angle significantly increased, after phacoemulsification and foldable IOL implantation, by approximately 50% of the initial value, by the measurement methods used: AOD250 ($P < 0.002$), AOD500 ($P < 0.001$).

As regard our groups; in group1, the mean change of AOD500 is 0.15±0.119mm which is a significant change ($P = 0.006$). While in group 2, the mean change of AOD500 is 0.071±0.0945mm which is not a significant change ($P = 0.066$) (Table 2). This can be explained as the cataract is near mature in group 1, so removal of the lens leads to a backward movement of the iris and increase in AOD, but in group 2 the lens is less mature so the change in iris profile is not enough to increase the AOD500 after surgery to a significant change.

Table (1): Demographic data (Age and sex):

Type	N	Mean ± SD	Male	Female
Extra-capsular	11	59.73 ± 8.742	6	5
Phaco	9	60.11 ± 7.149	5	4
Total	20	59.90 ± 7.860	11	9

Table (2): UBM parameters before and after cataract surgery

		Extra capsular (Mean ± SD)	Phaco (Mean ± SD)	Total (Mean ± SD)
AOD500	Pre	0.370 ± 0.128	0.424 ± 0.087	0.395 ± 0.112
	Post	0.523 ± 0.098	0.496 ± 0.1069	0.511 ± 0.1005
	Change	0.151 ± 0.119	0.071 ± 0.0945	0.115 ± 0.1139
	P value*	0.006	0.066	
ACA	Pre	33.82 ± 7.52	31.58 ± 6.22	32.82 ± 6.88
	Post	42.70 ± 7.93	40.00 ± 5.16	41.49 ± 6.80
	Change	8.87 ± 7.87	8.41 ± 6.44	8.66 ± 7.08
	P value*	0.008	0.015	
ACD	Pre	2.83 ± 0.357	2.76 ± 0.45	2.80 ± 0.39
	Post	3.65 ± 0.478	3.78 ± 0.68	3.71 ± 0.569
	Change	0.82 ± 0.59	1.01 ± 0.80	0.91 ± 0.68
	P value*	0.004	0.011	
ID1	Pre	0.38 ± 0.086	0.42 ± 0.055	0.40 ± 0.075
	Post	0.33 ± 0.07	0.41 ± 0.078	0.37 ± 0.084
	Change	- 0.049 ± 0.117	- 0.014 ± 0.102	- 0.033 ± 0.109
	P value*	0.213	0.594	
ID2	Pre	0.403 ± 0.08	0.42 ± 0.099	0.41 ± 0.092
	Post	0.391 ± 0.094	0.452 ± 0.090	0.41 ± 0.095
	Change	- 0.011 ± 0.065	0.026 ± 0.115	0.005 ± 0.09
	P value*	0.574	0.575	
ID3	Pre	0.47 ± 0.08	0.51 ± 0.17	0.49 ± 0.133
	Post	0.49 ± 0.09	0.49 ± 0.06	0.49 ± 0.07
	Change	0.02 ± 0.08	- 0.01 ± 0.160	0.004 ± 0.122
	P value*	0.593	0.327	
TCPD	Pre	1.18 ± 0.164	1.24 ± 0.081	1.20 ± 0.134
	Post	1.30 ± 0.127	1.250 ± 0.173	1.277 ± 0.148
	Change	0.119 ± 0.157	0.008 ± 0.126	0.069 ± 0.151
	P value*	0.068	0.678	
ILCD	Pre	0.32 ± 0.195	0.447 ± 0.127	0.38 ± 0.17
	Post	0.13 ± 0.265	0.14 ± 0.293	0.13 ± 0.27
	Change	- 0.195 ± 0.216	- 0.312 ± 0.226	- 0.248 ± 0.223
	P value*	0.028	0.015	
SCA	Pre	48.22 ± 6.13	50.81 ± 7.84	49.39 ± 6.89
	Post	48.23 ± 6.53	48.23 ± 5.22	48.23 ± 5.83
	Change	0.009 ± 9.08	- 2.578 ± 8.341	- 1.155 ± 8.629
	P value*	0.594	0.314	
IZD	Pre	0.677 ± 0.119	0.692 ± 0.157	0.683 ± 0.13
	Post	0.723 ± 0.286	0.858 ± 0.535	0.785 ± 0.400
	Change	0.016 ± 0.281	0.174 ± 0.390	0.088 ± 0.327
	P value*	0.917	0.345	
CLD	Pre	0.448 ± 0.171	0.541 ± 0.108	0.481 ± 0.1555
	Post	0.892 ± 0.647	0.915 ± 0.678	0.902 ± 0.618
	Change	0.372 ± 0.524	0.367 ± 0.625	0.370 ± 0.532
	P value*	0.138	0.465	

AOD500 = angle opening distance 500 µm anterior to the scleral spur; ACA = anterior chamber angle; ACD = anterior chamber depth; ID1= iris thickness 1; ID2= iris thickness 2; ID3= iris thickness 3; TCPD= Trabecular ciliary process distance; ILCD= iris-lens contact; SCA= scleral ciliary body angle; IZD= iris-zonule distance; CLD= ciliary process-lens distance.
*Wilcoxon signed ranks test, comparing preoperative and postoperative measurements.

- The anterior chamber angle:

The anterior chamber angle (ACA2) also called trabecular iris angle (TIA). From this study we found that, the mean ACA on UBM is increased by8.66°±7.08; this signifies an increase by 26.3% from the preoperative mean value (Table 2).

In group 1, the mean preoperative ACA was 33.82° ± 7.52 while the mean postoperative ACD was 42.7° ±7.93, there is significant change (P = 0.008). In group 2, the mean preoperative ACA was 31.58° ±6.22 while the mean postoperative ACA was 40.0° ±5.16, there is a significant increase of ACA (P = 0.015). The significant increase in ACA in both groups is supported by **Pereira and Cronemberger** [1] who reported an increase approximately 50% from the preoperative mean value in the ACA before and after phacoemulsification and foldable IOL implantation. In another study by **Guo et al.** [7], it has been demonstrated that the narrower the preoperative angle, the higher the postoperative values. Also **Dada et al.** [8] reported that there was almost 3 times increase in trabecular iris angle (TIA) postoperatively.

This could be because of the backward movement of the iris diaphragm away from the corneal inner surface and the flattening of the convex iris profile due to balancing of the pressures between the anterior and posterior chambers. A probable cause could be the elimination of the contact between the lens and the iris [1].

- Anterior Chamber Depth (ACD):

In our study, the mean ACD on UBM is increased by 0.91±0.68 mm. This signifies an increase by 32.5% from the preoperative mean value, measuring ACD from the posterior corneal surface to the anterior surface of the IOL optic (Table 2).

Previous UBM studies assessing anterior segment changes after cataract surgery reported significant deepening of the anterior chamber, with some measuring ACD from the posterior corneal surface to the pupillary plane [6], [1] and others to the anterior surface of the IOL optic [9], [10].

Pereira and Cronemberger [1] showed a 30% increase in ACD after phacoemulsification and foldable IOL implantation in 19 patients. **Dada et al.** [8] in their study on 46 eyes with chronic PACG and cataract, having a patent laser iridotomy, the mean ACD on UBM increased after phacoemulsification, IOL implantation by 75.6% from the preoperative mean value.

In our study; In group1, the mean preoperative ACD was 2.83±0.35mm while the mean postoperative ACD was 3.65±0.47mm, with the mean change of ACD is 0.82±0.59mm which is a significant change (P = 0.004). In group 2, the mean preoperative ACD was 2.76±0.45mm while the mean postoperative ACD was 3.78±0.68mm, with the mean change of ACD is 1.016±0.80 mm which is a significant change (P = 0.011) (Table 2).

Hayashi et al. [11] demonstrated quantitative anterior chamber deepening and opening of anterior chamber angles in eyes with PACG following phacoemulsification by Scheimpflug video photography. They also showed that the increase in ACD was much higher in the patients with narrow angles so that in the postoperative period the chamber depth of these patients became equal to the ACD of the patients with open angle glaucoma and those without glaucoma.

Our study also is agreed with **Pereira and Cronemberger** [1], who reported significant increase in ACD after surgery because of a backward movement of the iris diaghragm away from the corneal inner surface.

Nonaka et al. [12] have highlighted the pivotal role played by the lens with its anatomic peculiarities, increased thickness, and relative anterior positioning causing narrowing of the angles. They have reported an increase in mean ACD from 2.03 to 3.39 mm, and AOD500 from 0.09 to 0.25 mm after cataract extraction and IOL implantation.

- Iris thickness:

Iris thickness (ID1): From this study we found that, the mean ID1 is decreased by 0.033±0.109mm, this signifies decreasing by 8.25% from the preoperative mean value. In group1, there is no significant changes (P = 0.213), also in group2 there is no significant changes (P = 0.594) (Table 2).

Iris thickness (ID2): From this study we found that, the mean ID2 is decreased by 0.005±0.09mm, this signifies decreasing by 1.22% from the preoperative mean value. In group1, there is no significant changes (P = 0.574), also in group2 there is no significant changes (P = 0.575) (Table 2).

Iris thickness (ID3): From this study we found that, the mean ID3 is increased by 0.004±0.122mm, this signifies an increase by 0.81 % from the preoperative mean value. In group1, there is no significant changes (P = 0.593), also in group2 there is no significant changes (P = 0.327) (Table 2).

This result is in agree with **Pereira and Cronemberger** [1], who found no statistically significant difference in their study between the preoperative and postoperative measurements of iris thickness.

- Trabecular-Ciliary Process Distance (TCPD):

Pavlin et al. [2] reported that the TCPD is an important parameter indicating the width of the space available for containing the iris and is a typical feature of any eye. The TCPD is strongly influenced by the position of the ciliary processes, which in turn may be determined by the sclera ciliary process angle (SCPA).

From this study we found that, the TCPD on UBM is increased by 0.069 ±0.151mm, 5.75% more than the preoperative mean value. In group1, the mean preoperative TCPD was 1.18 mm ±0.164 while the mean postoperative TCPD was1.30 mm ± 0.127, with no significant changes (P = 0.068). In group 2, the mean preoperative TCPD was 1.24 mm ±0.081 while the mean postoperative TCPD was 1.25 mm ±0.173, with no significant changes (P = 0.678) (Table 2).

Same result was reported by **Pereira and Cronemberger** [1], who found no statistically significant difference in their study between the preoperative and postoperative measurements of TCPD.

- Iris-lens contact distance (ILCD):

Iris–lens or iris–IOL contact distances are variables of special interest when investigating pigment dispersion syndrome and glaucoma. In situations of blood–aqueous barrier breakage, contact of the posterior iris surface to the IOL or the anterior capsule may lead to posterior synechiae formation and IOL capture, and ultimately to pupillary block. Contact between IOL and uveal tissue, moreover when the IOL is implanted in the ciliary sulcus, was pointed out as an important etiologic factor in other IOL-related complications such as uveitis, glaucoma, hyphema, iris chafing, and pupillary distortion [1].

From this study we found that, the Iris-lens or iris-IOL contact distance on UBM is decreased by 0.248±0.223 mm, this signifies a decrease by 65.2% from the preoperative mean value (Table 2).

In the present study, iris–lens contact was observed in all eyes before surgery. After surgery, iris–IOL contact was observed only in 5 eyes, but none of the complications listed above have been observed, 14 pseudophakic eyes were implanted in the capsular bag, 6 in the ciliary sulcus.

As stated by **Kurimoto et al.** [6], the iris in phakic eyes was in contact with the lens, the iris in pseudophakic eyes was free from IOL contact, as long as it was implanted in the capsular bag.

Pereira and Cronemberger [1] in their study reported that iris–lens contact was observed in all eyes before surgery. After surgery, iris–IOL contact was observed only in two eyes. Those two patients received silicone lenses, which are thicker than the acrylic lenses. One of these patients had the smallest axial length of the entire sample studied, which may have contributed to the proximity of the IOL to the iris.

- Sclera-ciliary body angle (SCA):

In our study, the mean SCA on UBM is decreased by 1.155° ± 8.62. This signifies a decrease by 2.31% from the preoperative mean value. The difference between preoperative and postoperative was not found to be statistically significant in both groups. In group1, the mean preoperative SCA was48.22° ±6.13 while the mean postoperative was 48.23° ±6.53, (P =0.594). In group 2, the mean preoperative SCA was 50.81° ±7.84 while the mean postoperative was 48.23° ±5.22, (P =0.314) (Table 2). This result doesn't agree with **Pereira and Cronemberger** [1], who found statistically significant increase in SCA after surgery.

- Iris-Zonule distance (IZD):

From this study we found that, the mean IZD on UBM is increased by 0.088 ±0.327 mm, this signifies an increase by 12.8% from the preoperative mean value. In group1, the mean preoperative IZD was0.677 mm ±0.11 while the mean postoperative IZD was 0.723mm ±0.28, there is no significant changes (P value = 0.917). In group 2, the mean preoperative IZD was 0.692 mm ±0.157 while the mean postoperative IZD was 0.858 mm ±0.535, there is no significant changes (P value =0.345) (Table2).

Kurimoto et al. [6] reported similar results on studying 20 eyes without glaucoma.

- Ciliary Process Lens Distance (CPLD):

Kurimoto et al. [6], studied structures that participate in the anterior segment anatomy, such as the ciliary processes, the zonules and the iris. When the cataractous lens was removed, it was possible to balance the pressure in the anterior and posterior chambers by eliminating the contact between it and the iris.

In this study, CPLD is increased by 0.370 ±0.532 mm. In group1, the mean preoperative CPLD was 0.448 mm ±0.171 while the mean postoperative was 0.892 mm ±0.647, (P value =0.138). In group 2, the mean preoperative CPLD was 0.541 mm ± 0.108 while the mean postoperative was 0.915 mm ± 0.678, (P value = 0.465). The difference between preoperative and postoperative was not found to be statistically significant in both groups (Table 2).

Liebmann et al. [13], observed that when the pressures in the anterior and posterior chambers are different, there is corresponding change in the iris profile, as opposed to the flat profile observed when the pressures are balanced.

Our result is agreed with **Pereira and Cronemberger** [1] who observed that the ciliary processes and the zonules did not show significant changes in configuration after surgery.

- Position of IOL:

Before UBM was available cataract surgeons did not have a reliable postoperative technique to check whether the IOL haptics were really situated in the capsular bag as intended. Using UBM demonstrated the possibility of evaluating IOL implantation regarding the position of the IOL haptics [2].

The IOL haptics were implanted in the capsular bag, in a position unlikely to cause anterior displacement of the iris or angle structures. This is probably the normal configuration of the human angle in the supine position [1].

In this study, group1 showed that the haptics of the IOL were found to be in the capsular bag in 6 patients, in the sulcus in 5 patients. In group 2 the haptics of the IOL were found to be in the capsular bag in 8 patients, in the sulcus in 1 patient as detected by UBM.

Our result agrees with **Laurell et al.** [14], who examined 35 eyes that had undergone cataract surgery with UBM. They reported that both IOL haptics were found in the lens capsule in all 18 eyes patients were operated by phacoemulsification. In patients were operated by extracapsular cataract extraction one of the haptics was located out of the capsule in 7 of 17 eyes. Also they concluded that phacoemulsification with continuous curvilinear capsulorhexis is a more reliable technique than ECCE with linear capsulotomy to achieve implantation of the intraocular lens haptics in the capsular bag.

The anatomic changes observed in the present study agrees with previous studies, addressing cataract extraction and IOL implantation as might be an effective treatment option for patients with cataract and occludable angles. Further study with a larger group of patients, with different grading of the angle and with long-term follow up is necessary to confirm these results.

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