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Research Article

Role of Anterior Segment OCT in Precising Biometry of White Cataract

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ABSTRACT

Aim: To correlate between Anterior Segment Optical Coherence Tomography (AS-OCT) and ultrasonography to achieve precise Intraocular Lens (IOL) power of white cataract.

Materials and methods: A prospective non randomized study was conducted at a special eye center at Menoufia from October 2019 to February 2020. This study was conducted on 60 eyes of 60 patients with white cataract who were going to have elective unilateral standard phacoemulsification and IOL implantation. AS-OCT was performed preoperatively in all diseased individuals (n=30) which were categorized into 2 groups. Group 1 with presence of sub-capsular fluid pockets and those without any fluid are Group 2. Pre and postoperative data of both groups was recorded and compared.

Results: IOL power ranging from (20.0 D-24.0 D) with Mean ± SD. (22.0 ± 1.18) in cases with sub-capsular fluid pocket. In cases with no sub-capsular fluid pocket, IOL power ranging from (21.0 D-25.0 D) with Mean ± SD (23.37 ± 1.46). There was clinical significance between IOL power and sub-capsular fluid pocket (P=0.013). Post-operative follow up after one month show that refraction in cases with sub-capsular fluid pocket is hypermetropic more than 1 dioptre with Mean ± SD (1.27 ± 0.24). While refraction in all the diseased individuals without sub-capsular fluid pocket is nearly emmetropic with slight intended myopic shift with Mean ± SD (-0.93 ± 0.29).

Conclusion: Biometry for white cataract with sub-capsular fluid needs further research to get suitable formula.

Keywords: White cataract; Anterior Segment Optical Coherence Tomography (AS-OCT); IOL calculation

INTRODUCTION

Cataract surgery includes excision of the diseased tissue and implanting an IOL with the appropriate power calculation affects patient satisfaction and leads to a successful surgery. White, mature, senile cataract is an advanced form of cataract disease that may be associated with presence of sub-capsular fluid or not [1].

Cataract surgery requires achievement of good postoperative refractive results. In addition to good operative techniques, a precise calculation of the IOL power is of crucial importance to achieve good results after the surgery for cataract. The right calculations mainly focused on the accuracy of biometric preoperative data such as Axial Length (AL) of the eye, Anterior Chamber Depth (ACD), and corneal measurement readings. Incorrect calculation of the lens power is the main cause for patient dissatisfaction and lens replacement in modern cataract surgery [2].

Measurement of axial length, Lens Thickness (LT) using A-scan ultrasonography, is vital for accurate determination of power of implanted Intraocular Lens (IOL) for ideal refractive outcome [3].

The speed of sound is completely determined by the density of the medium through which the sound penetrates. Sound moves through solids faster than liquids, it is an important item to understand since the eye contains both. In A-scan biometry, sound passes through the cornea, aqueous humor, lens, liquid vitreous humor, retina, choroid, sclera, and orbital tissue. Therefore, it is constantly changing speed [4].

Herein, we describe using Anterior Segment Optical Coherence Tomography (AS-OCT) to analyze the presence or absence of fluid pockets under the anterior capsule and its impaction on biometry.

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MATERIALS AND METHODS

The study was a prospective case control study of 60 patients. The study was carried out in accordance with the ethical standards stated in the declaration of Helsinki and was approved by the Ethical Committee of Menoufia Medical School. The study protocol was explained to the patients and all cases were provided a written informed consent. The study was done at a special eye center at Menoufia from February 2019 to February 2020. This study included sixty eyes of sixty patients (32 males and 28 females ranging from 44-75 year-old) with white cataract that was going to have elective unilateral standard phacoemulsification and IOL implantation. Study included patients who had cataract with clear cornea and free posterior segment. Eyes with intense corneal opacity reaching descemet membrane, eyes with any other corneal or anterior segment pathology, eyes with any posterior segment pathology, eyes with history of corneal trauma and eyes with previous intraocular surgeries were excluded.

Examination

We obtained the medical histories of the cases from the volunteer. A complete ophthalmologic examination including best corrected visual acuity by decimal chart and assessment of colour vision was done. The anterior segment was carefully examined by slit lamp for corneal opacities or abnormalities, depth of anterior chamber, iris colour and pattern, regularity and uveitis, lens position and pupil reaction. By puff tonometer, the IOP was detected. Three averaged measurements were obtained per eye.

Using A- scan: (300A+PacScan plus from Sonomed)

This technique measures the distance from the corneal apex to the inner border membrane. Good alignment along the axis of the eye is important and requires patient cooperation. Because the probe is in direct contact with the cornea, there is a risk of corneal damage and infection. Therefore, topical, aesthetic and proper disinfection of the probe is required. The individual differences that occur depend largely on the pressure exerted by the ultrasonic probe on the eye. High pressure leads to corneal depression and shortening of AL. Biometrics can measure various eye dimensions such as AL, ACD, LT and Central Corneal Thickness (CCT). These values, along with corneal measurements, are essential for IOL performance calculations.

AS-OCT (Zeiss cirrus 4000 spectral domain OCT

AS-OCT was performed preoperatively in all patients (n=60) with mature/intumescent cataracts, and the presence or absence of fluid pockets under the anterior capsule was analyzed. The presence of sub-capsular fluid pockets (Group 1) and those without any fluid (Group 2).

Phacoemulsification was made to both groups and monitoring was done first day, one week, two weeks and one month post-operative recording refraction in each visit.

RESULTS

This study included 60 eyes of 60 individual. The main finding of the existence of a sub-capsular fluid pocket (Group 1) was detected in 30 eyes (50%) and no fluid pocket (Group 2) in 30 eyes (50%) with cataract (Table 1).

Table 1: Distribution of the studied cases according to sub-capsular fluid pocket (n=60).

Sub-capsular fluid pocket	No.	%
No	30	50
Yes	30	50

According to the relation with age there was sub-capsular fluid pocket in age ranging from (47.0-69.0) with Mean ± SD (61.36 ± 5.94). The absence of sub-capsular fluid pocket was found in age ranging from (44.0-75.0) with Mean ± SD (57.37 ± 10.57). No clinical statistical significance was found between both age (p=0.196) and sub-capsular fluid pocket.

Axial length ranging from (19.0-23.0) with Mean ± SD (20.45 ± 1.29) in patients with sub-capsular fluid pocket. In patients with absent sub-capsular fluid pocket, axial length ranging from (14.0-26.0) with Mean ± SD (18.74 ± 4.20). No clinical significance was found between axial length and sub-capsular fluid pocket, (P=0.112) (Table 2).

Table 2: Axial eye length between 2 groups.

Axial length	Total (n=60)	Sub-capsular fluid pocket		T	P
		No (n=30)	Yes (n=30)		
Min.-Max.	14.0-26.0	14.0-26.0	19.0-23.0	e1.652	0.112
Mean ± SD.	19.37 ± 3.50	18.74 ± 4.20	20.45 ± 1.29		
Median (IQR)	19.0 (17.0-21.0)	17.0 (15.50-21.50)	20.0 (19.50-21.0)		

Note: T: Student t-test; P: p-value for comparing between the studied groups

According to lens thickness, in patients with sub-capsular fluid pocket, lens thickness ranging from (4.30-5.40) with Mean ± SD (4.83 ± 0.38). In patients without sub-capsular fluid pocket, lens thickness ranging from (3.40-4.60) with Mean ± SD (3.84 ± 0.36). There was clinical significance between lens thickness and sub-capsular fluid pocket, (P=<0.001) (Table 3).

Table 3: Lens thickness between 2 groups.

Axial length	Total (n=60)	Sub-capsular fluid pocket		T	P
		No (n=30)	Yes (n=30)		
Min. – Max.	3.40-5.40	3.40-4.60	4.30-5.40	7.166*	<0.001*
Mean ± SD.	4.20 ± 0.60	3.84 ± 0.36	4.83 ± 0.38		
Median (IQR)	4.20 (3.60-4.60)	3.80 (3.60-4.15)	5.0 (4.50-5.10)		

Note: T: Student t-test; P: p-value for comparing between the studied groups; *: Statistically significant

According to IOL power, IOL power ranging from (20.0 D-24.0 D) with Mean ± SD (22.0 ± 1.18) in patients with sub-capsular fluid pocket. In patients without sub-capsular fluid pocket, IOL power ranging from (21.0 D-25.0 D) with Mean ± SD (23.37 ± 1.46). There was clinical significance between IOL power and sub-capsular fluid pocket (P=0.013) (Table 4).

Table 4: IOL power between 2 groups.

Axial length	Total (n=60)	Sub-capsular fluid pocket		T	P
		No (n=30)	Yes (n=30)		
Min.-Max.	20.0-25.0	21.0-25.0	20.0-24.0	2.640*	0.013*
Mean ± SD.	22.87 ± 1.50	23.37 ± 1.46	22.0 ± 1.18		
Median (IQR)	23.0 (21.0-24.0)	24.0 (22.50-24.0)	22.0 (21.0-23.0)		

Note: T: Student t-test; P: p-value for comparing between the studied groups; *: Statistically significant

Post-operative follow up after one month show that refraction in patients with sub-capsular fluid pocket is hypermetropic more than 1 dioptre while refraction in all the patients without sub-capsular fluid pocket is nearly emmetropic (Table 5).

Table 5: Comparison of postoperative refraction between two studied groups.

Axial length	Total (n=60)	Sub-capsular fluid pocket		T	P
		No (n=30)	Yes (n=30)		
Min.-Max.	-1.25-1.50	-1.25–0.50	1.0-1.50	7.6*	<0.001*
Mean ± SD.	-0.13 ± 1.11	-0.93 ± 0.29	1.27 ± 0.24		
Median (IQR)	-0.63 (-1.0-1.0)	-1.0 (-1.25–0.75)	1.25 (1.0-1.50)		

Note: T: Student t-test; P: p-value for comparing between the studied groups; *: Statistically significant

DISCUSSION

Correct calculation of IOL power is essential for optimal refraction results after cataract surgery. Accurate biometrics are important to reduce IOL performance calculation errors. Other than using accurate formulas, the most critical step in accurate IOL power detection is Axial Eye Length (AEL) measurement [5].

Applanation A-scan U/S biometry was the most widely used method for Axial Eye Length (AEL) measurement. However, this method may not be optimal in all situations. Optical bioassays focus on partially coherent light. Standard U/S biometry measures AEL from the apex of the cornea to the Internal Limiting Membrane (ILM), and optical biometry is a photoreceptor layer (0.25 mm) from the second main plane of the cornea (0.05 mm deeper than the tip of the cornea). Measure AEL up to deeper than the foveal ILM). This happens because the patient has the beam fixed inside the device. In contrast, in U/S biometry, measurements are performed along the anatomical or optical axis. However, optical biometry cannot fully replace U/S biometry because 10%-20% of eyes with dense cataract like white cataract cannot be measured with it. Therefore, in the present study we tried to search for the presence of sub-capsular fluid in white cataract and its impaction on biometry [6].

In present study significant statistical difference was found in post-operative refraction after one month between both groups. In group 1 without sub-capsular fluid we found that all cases were emmmetropic following the surgery while group 2 with sub-capsular fluid there was significant hypermetropic shift. This hypermetropic shift may be due one or both of the following factors:

1. There was clinical significance between lens thickness and sub-capsular pocket fluid (P=<0.001). In agreement with that results studies reveal correlation between lens thickness and sub-capsular fluid pocket [7], who studied thirty eyes of thirty patients, of which fifteen eyes (fifty percent) were with sub-capsular fluid and fifteen eyes (fifty percent) were without fluid on AS-OCT. This increase in lens thickness due to presence of fluid may play a role in changing Estimated Lens Position (ELP). Deviations in the preoperative estimation of postoperative IOL position, i.e., the ELP, represent the largest contribution to the mistake in modern IOL power detection forms [8]. So, improved ELP improves IOL power selection and provides refraction and visual results. A patient-specific eye model that includes information about lens volume, surface area, diameter, and equatorial plane position opens up the possibility of developing a new generation of equations for estimating IOL power [9].

2. The refractive hypermetropic shift in patients with sub-capsular fluid may be attributed to axial length which may result from slowing ultrasonic waves by fluid pockets which results in axial length slightly false longer than the actual one so the IOL power will be less than needed.

There was clinical significance between AL and the thickness of lens, (p=0.014). This agrees the results studies reveal correlation between AL and the thickness of lens [10], who studied 13,012 eyes of 6,506 patients who had cataract surgery he found that The AL and the thickness of lens were significantly correlated (p<0.001) [11], who studied the axial length and the thickness of the human lens in six hundreds eyes with cataract instance before surgery of cataract for visual rehabilitation. He demonstrated that the lens thickness was significantly correlated to the AL (P<0.003). In contrast with that results studies reveal no correlation between axial length and lens thickness [7], who studied thirty eyes of thirty patients, of which fifteen eyes (fifty percent) had sub-capsular fluid and fifteen eyes (fifty percent) without fluid on AS-OCT. Of the fifteen eyes in Group 1, thirteen eyes (eighty six percent). He found that the correlation of lens thickness with axial length showed a weak relationship with insignificant P values (0.997).

CONCLUSION

In the present study, biometry (A-scan) was performed preoperatively in patients with white cataract ,we found cases with sub-capsular fluid pockets on (AS-OCT) had the thickness of the lens and AL higher than cases without fluid pockets thus there was underestimation of intra ocular lens in cases with sub-capsular fluid.

Post-operative refraction following phacoemulsification for white cataract differs between white cataract with sub-capsular fluid and those without sub-capsular fluid. Cases with sub-capsular fluid have hypermetropic postoperative refraction denoting underestimated IOL power. So we recommend for searching for IOL calculations formula for this type of cataract.

RECOMMENDATION

We recommend searching for more matched formula for white cataract with sub-capsular fluid.

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