

Original Article

## Changes in anterior chamber depth and intraocular pressure at day one after uneventful phacoemulsification surgery

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### ABSTRACT

**Objectives:** This study aimed to determine the relationship of anterior chamber depth (ACD) change toward intraocular pressure (IOP) at day 1 after phacoemulsification surgery and intraocular lens implantation.

**Materials and Methods:** This is an analytical cross-sectional study. Data were extracted from medical records of cataract patients above the age of 40 years who underwent phacoemulsification surgery at Christian University Hospital from September to November 2019. Each participant's ACD (biometry) and IOP (non-contact tonometry) were determined before and on day 1 after phacoemulsification surgery. Comparison of ACD and IOP measurements was done using paired *t*-tests and the relationship was analysed with Pearson correlation testing.

**Results:** Twenty-five eyes were included in this study. ACD pre-operative was  $2.99 \pm 0.599$ , and day 1 post-operative was  $3.42 \pm 0.349$ . ACD was significantly deepened on day 1 post-operative ( $P = 0.001$ ). The mean pre- and 1-day post-operative IOP were  $18.16 \pm 3.460$  and  $17.32 \pm 5.429$ , respectively ( $P = 0.412$ ). No relationship was found between ACD and IOP pre-operative ( $P = 0.178$ ). There was a statistically significant relationship between ACD and IOP day 1 post-operative ( $P = 0.002$ ).

**Conclusion:** ACD was significantly deepened 1 day post-operative, and there was a statistically significant relationship between ACD and IOP 1 day post uneventful phacoemulsification surgery.

**Keywords:** Cataract, Phacoemulsification, Anterior chamber depth, Intraocular pressure, One-day time interval

### INTRODUCTION

Approximately 95 million people worldwide experience visual disturbances due to cataracts.<sup>[1]</sup> Cataract is a reversible vision disorder.<sup>[2]</sup> The estimated incidence of cataracts is 0.1%/year or 1000 people/year.<sup>[1-3]</sup>

Surgery is the only management to regain vision loss due to cataracts.<sup>[4]</sup> Over the past two decades, the development of cataract surgical techniques has decreased the prevalence of cataract morbidity.<sup>[5]</sup> However, in cataract surgery, the inflammatory reaction from removing the lens has an impact on the physiological and anatomical state of the eye. This change occurs in the anatomy of the anterior chamber and the aqueous humour.<sup>[1,2]</sup>

The anterior chamber of the eye plays an important role in the flow of the aqueous humour. In the anterior chamber, if there is no obstacle to the trabecular meshwork, the aqueous humour will flow and be absorbed easily. However, if the anterior chamber has a narrow angle or if there is an

obstacle to the trabecular meshwork, the flow of aqueous humour will be obstructed. This results in an increased intraocular pressure (IOP).<sup>[3]</sup> Cataract surgery can deeply alter the segment anterior morphology, especially anterior chamber depth (ACD) and influence IOP change in every subject. Cataract surgery may alter IOP postoperatively, and the majority of studies have reported a decrease in IOP in both normal and glaucomatous eyes.<sup>[1,3,5,6]</sup>

The depth of the anterior chamber and IOP are two important factors in improving visual acuity after cataract surgery. Our study aimed to investigate whether there was a relationship between phacoemulsification surgery and changes in the depth of the anterior chambers and IOP.

### MATERIALS AND METHODS

This was a cross-sectional study conducted from September to November 2019 at Universitas Kristen Indonesia Hospital.

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We recorded all patients diagnosed with cataracts and underwent uneventful cataract surgery done by one operator. The sample collected was 47 eyes with a total sampling technique. We determined the eligible subjects into inclusion criteria were patients diagnosed with cataracts, age  $\geq 40$  years, and underwent uneventful phacoemulsification surgery. Meanwhile, congenital cataracts, traumatic cataracts and cataracts with a history of metabolic disease were excluded from the study. The included samples were evaluated on the 1<sup>st</sup> day after surgery and ruled out if there were any signs of inflammation, such as flares and cells on the anterior chamber. Eligible samples collected became 25 eyes in this study.

Pre-operative evaluation included a visual acuity test using a Snellen chart, slit-lamp examination, routine fundus examination, gonioscopy and IOP determination. ACD was measured using biometry ultrasonography-A preoperatively and day 1 postoperatively. IOP measurement was obtained thrice using Goldmann Contact Tonometry with 1 mmHg disparity consecutively pre-operative and day 1 postoperative.

Phacoemulsification surgery was done with the stop-and-chop technique without any complications. The corneal main port was incised with a 2.75 mm keratome. We put hydroxypropyl methylcellulose, an inert polymer that forms a viscoelastic solution, in the anterior chamber of aqueous media. Continuous curvilinear capsulorrhexis and hydro dissection were performed smoothly without complication (no posterior capsule rupture). After phacoemulsification was done, intra ocular lens (IOL) was implanted and the remaining lens cortical was aspirated. The wound of the main and second port was closed by making corneal oedema. Patient's data were recorded on day 1 post-operative without any medication given. Then, the data were processed using T-paired analysis and Pearson correlation test with the Statistical Package for the Social Sciences.

## RESULTS

### Baseline characteristics

Twenty-five eyes of 25 patients were eligible as samples in this study. Most patients (76%) were above the age of 60 years, and females doubled the number of males. The patients' characteristics are shown in Table 1.

### The mean value of the anterior chamber depth (ACD) before and day 1 after phacoemulsification surgery

There was an increase in the mean ACD a day after phacoemulsification [Table 2]. Using a paired *t*-test, there was a significant change in the depth of the anterior chamber

**Table 1:** Baseline subject characteristics.

	Frequency (n)	Percentage
Age (years)		
$\leq 60$ years	6	24
$> 60$ years	19	76
Gender		
Male	8	32
Female	17	68
Eyes		
Right eye	13	52
Left eye	12	48
Total	25	100

before and after phacoemulsification of  $\pm 0.425$  mm  $P = 0.001$ .

### The mean value of the intraocular pressure (IOP) before and day 1 after phacoemulsification surgery

There was a decrease in the mean IOP a day after phacoemulsification [Table 3]. The paired T statistical test shows that there was no significant change in IOP before cataract surgery and after cataract surgery ( $P = 0.412$ ).

### The relationship between the depth of the anterior chamber with intraocular pressure (IOP) before and after surgery

With the Pearson correlation test, the results showed no significant relationship between the depth of the anterior chambers of the eye to IOP ( $P = 0.178$ ) before the cataract surgery [Table 4]. Meanwhile, statistical tests for IOP after surgery show that there is a significant relationship between the depth of the anterior chamber with IOP after 1 day of the phacoemulsification procedure ( $P = 0.002$ ).

## DISCUSSION

In this study, we found an increase in the depth of the anterior chamber and a decrease in IOP 1 day after uneventful phacoemulsification and IOL implantation. The depth of the anterior chamber increased significantly ( $P = 0.001$ ) by  $\pm 0.425$  mm after surgery. IOP reduction showed insignificant results ( $P = 0.412$ ) of  $\pm 0.84$  mmHg after surgery. In a previous study, it was reported that from 124 eyes, there was an average reduction in IOP of 1.5–8.3 mmHg after phacoemulsification cataract surgery with or without glaucoma.<sup>[4,7]</sup> In the case of chronic primary angle closure glaucoma (PACG), the decrease in IOP after cataract surgery was 2.1–8.5 mmHg.<sup>[8]</sup> IOP reduction occurs proportionally before and after surgery. The higher the pre-operative IOP, the greater the decrease in IOP after surgery.<sup>[2,4]</sup> The previous studies have explained that the deeper the anterior ocular

**Table 2:** Mean value of ACD before and after phacoemulsification surgery.

ACD	n	Minimum	Maximum	$\bar{X} \pm SD$	Mean differential	P-value
Before surgery	25	1.78	3.85	2.99±0.599	-0.425	0.001
After surgery	25	2.83	4.40	3.42±0.349		

ACD: Anterior chamber depth, SD: Standard deviation

**Table 3:** Mean IOP value before and after phacoemulsification surgery.

IOP	n	Minimum	Maximum	$\bar{X} \pm SD$	Mean differential	P-value
Before surgery	25	13	26	18.16±3.460	0.840	0.412
After surgery	25	10	38	17.32±5.429		

IOP: Intraocular pressure, SD: Standard deviation

**Table 4:** Relationship of the depth of the front chamber with IOP before and day 1 after cataract surgery.

	N	R	P-value
Depth of the front chamber before surgery	25	-0.279	0.178
IOP before surgery	25		
Depth of the front chamber day 1 after surgery	25	0.582	0.002
IOP after surgery	25		

IOP: Intraocular pressure, N: Number of data, R: Correlation coefficient

chamber, the shorter the length of the axial eyeball and high pre-operative IOP is associated with a higher decrease in IOP after surgery.<sup>[4,7]</sup>

Several factors that could determine the IOP after phacoemulsification, such as surgical trauma, watertight wound closure, retained lenticular debris, the release of iris pigment, hyphema and inflammation, are also thought to contribute to elevations in IOP.<sup>[5,9]</sup> The skillfulness of the surgeon has been implicated as well. The depth of camera oculi anterior (COA) is defined as the distance between the central endothelium of the cornea to the anterior pole of the lens or IOL, which is an indicator of the axial position of the IOL after surgery.<sup>[5,10]</sup> This study shows that the mean value of the depth of COA before surgery was 2.99 mm ± 0.599. Moreover, after surgery, it was 3.42 mm ± 0.349. There was a significant difference ( $P = 0.001$ ) in the ACD before and 1 day after cataract surgery. This is in accordance with the previous studies; the COA depth before surgery from 45 eyes was 2.75 ± 0.43 mm and 2 days after surgery was 4.14 ± 0.31 mm. In Kim's study, the depth of COA increased significantly ( $P < 0.001$ ) by 50.5% at 2 days after surgery. However, these results showed a negative correlation between pre-operative and post-operative COA depth ( $r = -0.680$ ,  $P < 0.01$ ).<sup>[5]</sup> The post-operative COA depth increased with the pre-operative COA depth and the eyeball axis length.<sup>[5,10]</sup> Changes in COA depth greater with pre-operative shallower (1.92 ± 0.40 mm) than

deeper pre-operative COA (1.33 ± 0.42mm) ( $P < 0.001$ ) lens thickness increased with age, accompanied by movement of the anterior surface of the lens toward the cornea. This causes the depth of the COA and the angle of the eyeball in cataract patients to be narrower than in normal patients.<sup>[5,10,11]</sup> The depth of the post-operative COA becomes deeper and becomes more stable gradually after 2 weeks.<sup>[10]</sup> The changing axial position is caused by the reduction in size that occurs in the capsular bag.<sup>[2]</sup>

However, our study has limitations and only describes data on day 1 after uneventful cataract surgery. This study needs a bigger sample size, and the depth of COA and IOP should be measured not only on 1<sup>st</sup> day but also 1 month consecutively after cataract surgery to describe more reliable data on IOP and ACD stability.

## CONCLUSION

In this study, it was found that phacoemulsification surgery caused an insignificant decrease in IOP, followed by a significant increase in the depth of COA 1 day after uneventful phacoemulsification surgery. However, studies with longer follow-up times are needed to reassess the effect of phacoemulsification cataract surgery on IOP.

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## Ethical approval

The Institutional Review Board has waived the ethical approval for this study

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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