

# The Effect of Phacoemulsification with Posterior Chamber Intraocular Lens Implantation on Intraocular Pressure and Anterior Chamber Depth

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## Abstract

**Purpose:** To evaluate intraocular pressure (IOP) and anterior chamber depth (ACD) change after phacoemulsification with posterior chamber intraocular lens implantation

**Methods:** In this quasi-experimental study, 84 patients with senile cataract were included. All patients had normal IOP. Patients with traumatic and complicated cataract, any history of uveitis, glaucoma, or other ocular disease or surgery were excluded. Patients underwent phacoemulsification and intraocular lens implantation by the same surgeon. IOP, ACD, and lens thickness were measured and recorded before surgery. IOP was measured at 4, 8 and 12 postoperative weeks and ACD was measured 12 weeks after surgery.

**Results:** The mean preoperative ACD significantly increased from 2.93 mm to 3.54 mm postoperatively ( $p < 0.0001$ ). Mean preoperative IOP was 16.06 mmHg which decreased to 12.01 IOP mmHg, 12.57 mmHg and 12.90 mmHg at 4 weeks, 8 weeks and 12 weeks postoperatively, respectively (all  $p$ -values  $< 0.0001$ ). There was a correlation between lens thickness and changes of and ACD after the surgery. There was also a positive correlation between preoperative IOP and IOP reduction after the surgery.

**Conclusion:** Phacoemulsification decreases IOP specially in eyes with higher preoperative IOP and thicker lenses.

**Keywords:** Phacoemulsification, Anterior Chamber Depth, Intraocular Pressure, Lens Thickness

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## Introduction

Cataract and glaucoma are two important causes of visual impairment that affect older population in the world.<sup>1</sup> Multiple studies have addressed the effect of uneventful phacoemulsification with intraocular lens implantation on anterior chamber anatomy<sup>2</sup> and intraocular pressure (IOP).<sup>3-8</sup> These studies have reported mean IOP reduction after cataract surgery but the amount of this reduction shows wide variations.<sup>8</sup> In addition although a few studies have evaluated the determinants of this reduction,<sup>7,9</sup> factors predicting the amount of IOP reduction after phacoemulsification with intraocular lens implantation continues to be a matter of debate. Specially lens thickness is one of the anatomic parameters of the anterior chamber that seems to affect IOP change after cataract surgery<sup>7</sup> but its contribution needs further study.

Although the most common way to control IOP in medically uncontrolled glaucoma are glaucoma filtering procedures but they do have significant risks.<sup>10,11</sup> Considering that many patients with glaucoma have concurrent cataracts, it seems reasonable to study the effect of cataract surgery on IOP changes and considering this effect to choose the patients in whom cataract surgery alone could be a safe alternative for glaucoma surgery.

## Methods

In this prospective study, 84 eyes of 84 patients with senile cataract who referred to Rasht Amiralmomenin Hospital (Guilan University of Medical Sciences) from January 2010 to May 2010 were enrolled. The study protocol was reviewed and approved by the Institutional Ethics Committee of Guilan University of Medical Sciences. Informed consent was obtained from all patients preoperatively.

Patients with traumatic and complicated cataract, corneal pathology, glaucoma, pseudoexfoliation, uveitis, previous eye surgery or eye trauma, posterior segment pathology, diabetes, and those using topical or systemic medications that might influence anterior segment parameters and IOP measurements were excluded from the study. All patients underwent full ophthalmic examination including best corrected visual acuity (BCVA), slit-lamp biomicroscopy,

funduscopy, and tonometry. All IOP measurements were done between 2 and 4 pm with non-dilated pupil. Preoperative IOP was recorded as a mean of two IOP readings measured by Goldmann applanation tonometry. Anterior chamber depth (ACD) and lens thickness were measured ultrasonographically by NIDEK A-scan US-800 (Japan).

All surgeries were performed under peribulbar anaesthesia by the same surgeon (R.S.M). A 3.2 mm temporal clear corneal incision was created. A 5-6 mm capsulorhexis, phacoemulsification (Alcon Series 20000 Legacy), and irrigation/aspiration were performed. Foldable intraocular lens (KontourGmbH, Boehringer, Germany) was implanted after capsular bag filling with viscoelastic. Viscoelastic was aspirated and the incisions were hydrated with balanced salt solution. Postoperatively patients were prescribed topical antibiotic for one week and a topical steroid in tapering dosage for four weeks.

Demographic data including age, gender, and number of eyes were collected. Postoperatively, patients assessed at 4 weeks, 8 weeks, and 12 weeks for IOP measurement and at 12 weeks for ACD measurement.

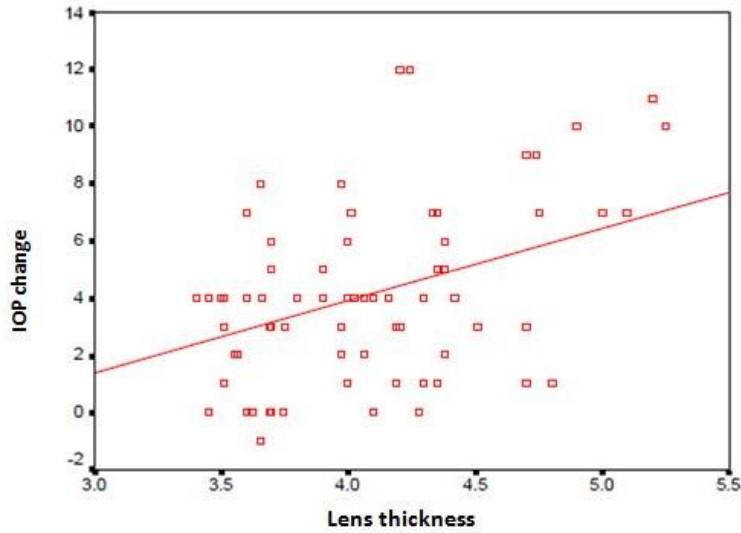
All statistical analysis were performed using SPSS for windows, Version 18.0 (SPSS, Inc., Chicago, IL, USA). The paired T-test and Pearson correlation tests were used to compare means and value was considered statistically significant ( $p < 0.05$ ).

## Results

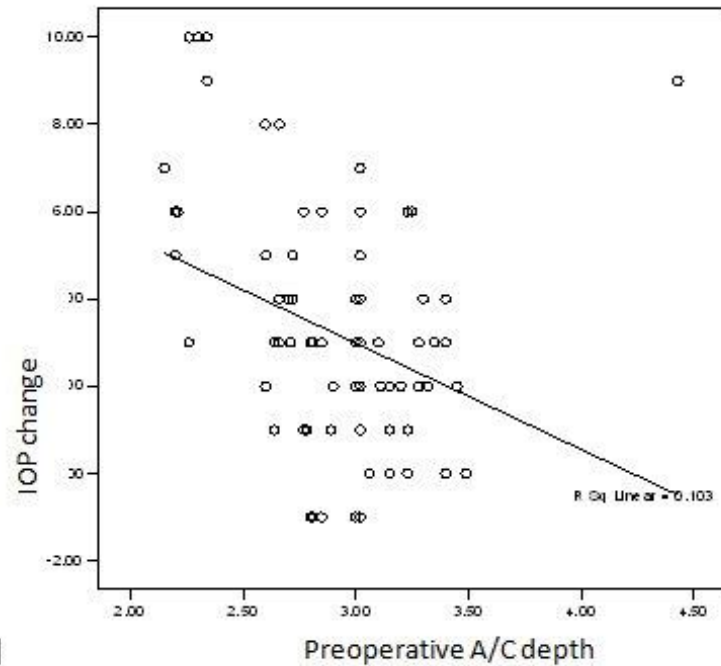
Eighty-four eyes of 84 patients were included in this study and underwent surgery. Mean age was  $65.73 \pm 10.56$  (range, 41 to 84 years). There were 39 males (46%) and 45 (53%) females. Mean preoperative ACD was  $2.93 \pm 0.36$  mm (range, 2.15 to 4.43 mm) which significantly increased to  $3.54 \pm 0.25$  mm (range, 2.95 to 4.50 mm) 12 week postoperatively ( $p < 0.0001$ ). The mean preoperative IOP was  $16.06 \pm 3.11$  mmHg (range, 11 to 25 mmHg) that significantly decreased at all time-points as shown in table 1. Mean lens thickness was  $4.05 \pm 0.46$  mm (range, 3.40 to 5.25 mm). Pearson correlation was revealed a positive correlation

between lens thickness and ACD change ( $p=0.015$ ,  $r=0.264$ ). Also a positive correlation was found between lens thickness and postoperative IOP reduction at 12 weeks ( $p=0.0001$ ,  $r=0.4$ ) (Figure 1). In addition, we found a positive correlation between

preoperative IOP and magnitude of IOP reduction at 12 weeks ( $p=0.0001$ ,  $r=0.68$ ). A negative correlation was observed between preoperative ACD and postoperative IOP reduction ( $p=0.003$ ,  $r=-0.322$ ) (Figure 2).



**Figure 1.** Correlation of lens thickness and postoperative IOP change ( $p=0.0001$ ,  $r=0.4$ )



**Figure 2.** Correlation of preoperative anterior chamber depth and postoperative IOP change ( $p=0.0001$ ,  $r=0.678$ )

**Table 1.** Comparison of intraocular pressure before and after cataract surgery

Time	Mean±SD (mmHg)	p-value
Before operation	16.06±3.11	p<0.0001
Four weeks after operation	12.01±2.38	
Before operation	16.06±3.11	p<0.0001
Eight weeks after operation	12.57±2.34	
Before operation	16.06±3.11	p<0.0001
Twelve weeks after operation	12.9±2.35	

## Discussion

Many studies have reported IOP reduction after cataract surgery.<sup>3,5-8</sup> The exact mechanism is not clear. One possible mechanism is widening of the irido-corneal angle by removing the lens as proposed by Hayashi et al.<sup>5</sup> This mechanism is probably mostly involved in patients with narrow iridocorneal angles; angle width either does not change or changes minimally in patients with open angles.<sup>12</sup> Therefore, IOP reduction after phacoemulsification in these eyes may be due to other mechanisms such as increased trabecular flow. One proposed explanation is that high flow of fluid and high IOP during phacoemulsification forces fluid through the trabecular meshwork, which may result in increased patency of trabecular meshwork.<sup>13</sup> Another hypothesis suggests that cataract surgery may cause a low grade (but sustained) inflammation that reduces IOP either by ciliary body hyposecretion or increased outflow, as prostaglandin analogues do.<sup>13</sup>

It seems that phacoemulsification with IOL implantation reduces the rate of conversion of ocular hypertension (OHT) to glaucoma. Ocular Hypertension Treatment Study<sup>14</sup> showed the rate of conversion in the observation group (no treatment) to be 9.5% but this rate was 4.4% in group taking glaucoma drops. Poley et al<sup>8</sup> showed that in the patients with OHT who undergo phacoemulsification with IOL implantation the risk of conversion to glaucoma was 1.1%.

In this study, the mean preoperative IOP was 16.06±3.11 mmHg that significantly decreased to 12.01±2.38 mmHg at 3 months postoperatively. Therefore, we observed a mean IOP reduction of 4 mmHg (24.9%). Irak-Dersu et al<sup>7</sup> reported 7.8% IOP reduction 3 months postoperatively in their study on normal eyes undergoing phacoemulsification. This difference can only partially be related to

differences between preoperative ACD between our two studies (2.93 mm in our study versus 3.20 in theirs). On the other hand, Uçakhan et al<sup>4</sup> in a study performed on the normotensive patients undergoing phacoemulsification showed 16.45% IOP reduction 3 months postoperatively. Preoperative ACD of patients in that study was 3.0±0.8 mm.

Many factors have been reported to affect IOP changes after cataract surgery. The preoperative ACD and angle width have been shown to be inversely related to IOP reduction after phacoemulsification.<sup>2-5</sup> In our study, the mean preoperative ACD was 2.93 mm, which significantly increased to 3.54 mm postoperatively. The patients with lower ACD had more increase in ACD after surgery and postoperative ACD changes were positively correlated with postoperative IOP reduction (p=0.01, r=0.28). In our series of patients the mean preoperative ACD in comparison to other studies performed on non-glaucomatous patients was less than what was suggested to be the reason for greater reduction in IOP. Some studies have shown that patients with higher preoperative IOP have more postoperative IOP reduction after cataract surgery.<sup>8,15,16</sup> Poley et al<sup>8</sup> stratified the patients in their study according to their preoperative IOP. Mean IOP reduction was 34% in the 29 to 23 mmHg group, 22% in 22 to 20 mmHg group, 18% in 19 to 18 mmHg group, and 10% in 17 to 15 mmHg group. Our study also showed a positive correlation between preoperative IOP and postoperative IOP reduction, patients with higher preoperative IOP gained more IOP reduction after phacoemulsification.

Issa et al<sup>9</sup> developed a novel ratio, the pressure to depth (PD) ratio (preoperative IOP/preoperative ACD). They found that this ratio is significantly and positively related to

the surgically induced reduction in IOP, and IOP was reduced by >4 mmHg in all patients with a PD ratio > seven. This means that postoperative IOP reduction is more significant in patients with higher preoperative IOP and lower preoperative ACD, which is similar to results of our study. We also investigated the correlation of PD ratio to postoperative IOP change in our study and we found a strong positive correlation ( $p < 0.0001$ ,  $r = 0.7$ ).

Our study confirmed a positive relation between postoperative IOP reduction and lens thickness, similar to results found by Irak-Dersu et al.<sup>7</sup> Patients with pseudoexfoliation are considered to have more IOP reduction after cataract surgery<sup>17,18</sup> but the contribution of this factor has not been evaluated in this study.

The most noticeable limitation of this study is short duration of the follow-up.

## Conclusion

Our study showed that phacoemulsification decreases IOP specially in eyes with lower ACD, higher preoperative IOP and thicker lenses.

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