

# Effect of Cataract Surgery on Intraocular Pressure in Non-Glaucomatous Patients- A Prospective Study

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## ABSTRACT

### BACKGROUND

Variations in the IOP beyond the normal range can lead to different pathologies that are associated with difficulty in vision. Inside the closed space of the globe, cataractous changes along with never ending growth of crystalline lens have been theoretically thought to be associated with a rise in IOP. Distribution of different types of cataracts and the sequential change of IOP in different morphological types of cataract after phacoemulsification with foldable PCIOL implantation in the capsular bag is the sole aim of this study.

### METHODS

This is a prospective observational study. Selected patients with no features of glaucoma, after meeting proper inclusion and exclusion criteria were included in the study. 426 eyes underwent phacoemulsification with PCIOL implantation (by a single competent surgeon using same phacoemulsification machine with similar parameters) were subjected to measurement of IOP by Goldmann Applanation Tonometry 3 days prior to surgery and postoperative day 14 and 28 respectively. Before surgery, dilated pupillary examination was performed to assess the grade of cataract. Data was collected and results analysed thereafter.

### RESULTS

Among 426 eyes evaluated (M:F=1.8:1), with mean age of 54.49 ( $\pm 6.975$ ) yrs., commonest type of cataract found was Nuclear Sclerosis Grade III (19.9%) followed by Nuclear Sclerosis Grade II (16.4%). Mean preoperative IOP was 16.55 ( $\pm 1.953$ ) mmHg. Mean postoperative IOP on day 14 and day 28 was 15.11 ( $\pm 1.755$ ) mmHg and 15.04 ( $\pm 1.800$ ) mmHg respectively. Nuclear Sclerosis grade V had the least preoperative IOP among all the groups whereas mature cataracts with highest preoperative IOP showed highest fall of IOP after surgery. 8.2% patients who had traumatic cataract which did not show significant postoperative reduction of IOP.

### CONCLUSIONS

Cataract surgery by phacoemulsification and PCIOL implantation reduces IOP in majority of non-glaucomatous patients. Non-diabetic, non-traumatic cataracts and mature cataracts show maximum postoperative reduction of IOP.

### KEYWORDS

Phacoemulsification, IOP, Traumatic Cataract, DM

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## BACKGROUND

Intraocular pressure (IOP) is maintained by dynamic equilibrium between the production and drainage of aqueous humour in physiological condition.<sup>1</sup> In large scale studies it has been noted that increased outer coat rigidity along with conformational change in trabecular outflow system attributed to rise of IOP with advancement of age.<sup>2,3</sup> Being in a closed viscera, every small volume plays an important role in the change of IOP. As crystalline lens grows throughout life and because of its anatomical position, it has become a key factor in changes of IOP. Cataractous lens removal with posterior chamber IOL implantation in capsular bag to make the patient emmetropic, additively decrease the IOP.<sup>4,5</sup>

### Aims and Objective

1. To study the changes of IOP after cataract surgery in non-glaucomatous patients.
2. To compare the differential changes of IOP after surgery in different types of cataract.
3. To evaluate the effect of cataract surgery on IOP in traumatic cataract.
4. To compare the differential changes of IOP after surgery between non-diabetic, type I DM and type II DM patients.

## METHODS

This is an institution based prospective observational study conducted among patients attending OPD at RIO – Kolkata for diminution of vision or any other ocular complaints and who underwent cataract surgery from 01/01/2018 to 30/06/2018. 396 such patients were taken. Some patients underwent cataract extraction of both eyes followed by PCIOL implantation. For this purpose, each eye undergoing evaluation was considered as a separate case. Thus, total 426 eyes were taken into the study.

### Inclusion Criteria

1. Age >30 years.
2. Any cataract irrespective of its maturity with uncomplicated cataract surgery.
3. Patients willing to take part in the study.

### Exclusion Criteria

1. Eyes which developed Glaucomatous changes during the period in which the study was conducted.
2. Developmental cataract.
3. Ongoing ocular diseases other than cataract.
4. Uncontrolled Hypertension and Diabetes Mellitus.
5. Drug induced cataract (example steroid induced cataract).
6. Any complication arising during the period of study e.g. intraoperative posterior capsule rupture, patient kept aphakic or implantation of IOL in the ciliary sulcus.
7. Patient not willing for the study or who refused to attend on particular date.

### Control

No controls were required for this study.

### Study Tools

- a. Snellen's chart and Jaeger's chart for refraction test.
- b. Topcon slit lamp biomicroscope.
- c. Volk 90D lens.
- d. Volk 20D lens.
- e. Appasamy Associates Indirect Ophthalmoscope.
- f. Appasamy Associates USG machine.
- g. Heidelberg OCT machine.
- h. Zeiss HFA machine.
- i. Topcon OT microscope and AMO Sovereign Compact System with whitestar technology phacoemulsification machine.
- j. AT prism.
- k. Two-mirror Gonio lens.

### Study Technique

Patients attending RIO Kolkata, male or female, above 50 years of age having cataract without any glaucomatous changes with best corrected visual acuity worse than 6/18 in either eye after refraction test or who wants to have the cataract surgery done were primarily taken for the study. History was taken and inclusion-exclusion criteria applied. Routine glaucoma evaluation done followed by slit lamp examination to rule out any pathology in the eye and grading of the cataract (nuclear sclerosis: 0-V, posterior subcapsular cataract, mature cataract).<sup>6</sup> Dilated fundoscopic examination of both eyes was performed in presence of attendants with direct ophthalmoscope, slit lamp and 90D lens and with the help of binocular indirect ophthalmoscope and 20D lens, in a semi dark room. Goldmann Applanation tonometer, which is maintained by periodic accurate calibration, was used to measure the IOP in each eye 3 days prior to surgery. 2 successive readings were noted returning the tonometer dial at 10 mmHg between readings. If the first two measurements are within 2 mmHg, the mean IOP was used otherwise a third IOP was taken and the median of the readings were taken.<sup>7</sup> After uncomplicated cataract surgery by a single competent eye surgeon, IOP was measured by same method by the same surgeon at the similar time of the day on Day 14 and Day 28. Data were collected and tabulated in excel sheet and SPSS version 20 was applied for statistical analysis.

All the eyes were operated by a single competent ophthalmic surgeon. The surgeon doing the cataract surgery and the one measuring the IOP was different. The surgeon measuring the IOP at 3 visits was the same. Some patients underwent cataract extraction of both eyes and after meeting the inclusion and exclusion criteria, each eye was taken as a separate case.

### Data Analysis

After collection, the data were compiled in Microsoft excel data sheet and SPSS version 20 were used to do the statistical calculation. Paired-t test, Repeated Measurement

General Linear Model Analysis test were done to test the significance ( $p < 0.05$  is considered as significant).

RESULTS

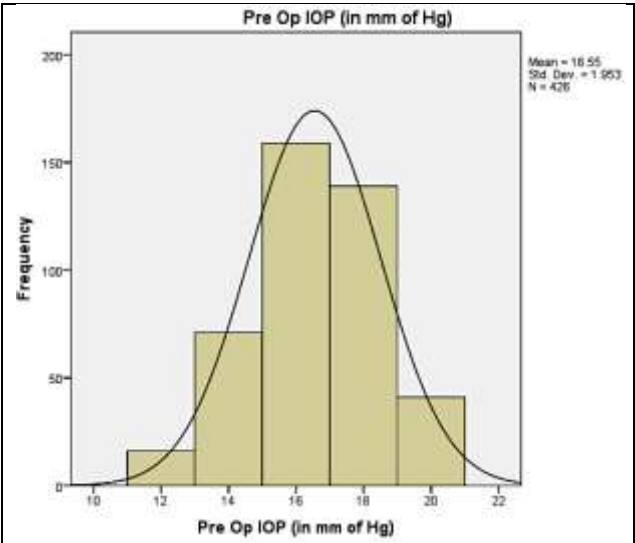


Figure 1. Distribution of Patients According to IOP Pre-Operatively

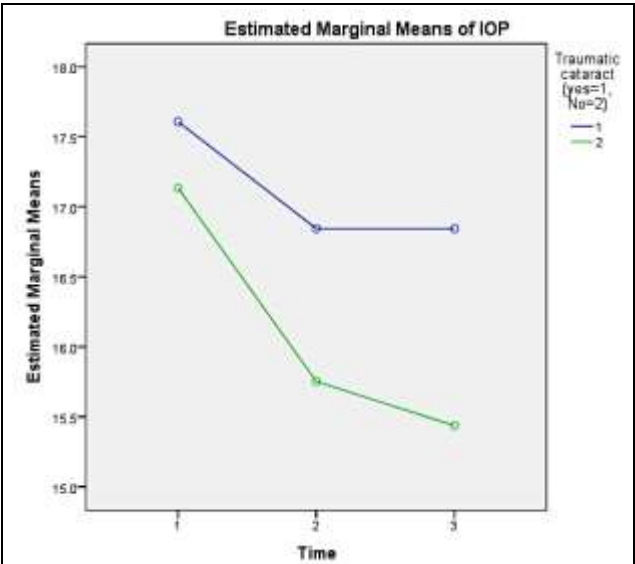


Figure 2. Mean IOP and Their Reduction Plots According to History of Trauma Showing Significant Reduction in Non-traumatic Cataracts (Sig: 0.000) ( $p < 0.05$ )

Grade of Cataract	Frequency	Percent
2.	27	6.3
2+8	51	11.9
3.	70	16.4
3+8	66	15.5
4.	85	19.9
4+8	9	2.1
5.	51	11.9
7.	9	2.1
8.	58	13.6
Total	426	100.0

**Table 1. Distribution of Patients According to Type of Cataract**

Grade of Cataract (NS0=1, NS1=2, NS2=3, NS3=4, NS4=5, NS5=6, Mat Cat=7, PSC=8)

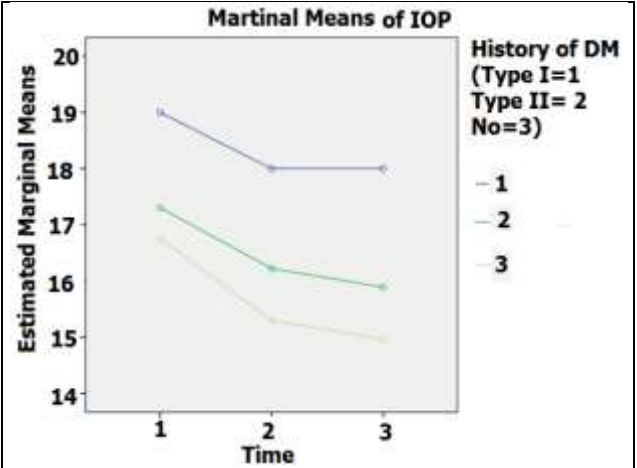


Figure 3. Mean IOP and Their Reduction Plots According to History of DM Showing Significantly High IOP in Type I DM than Other and Significant Reduction in Non-Diabetic Groups (Sig: 0.000) ( $p < 0.05$ )

	Mean	Std. Deviation		Sig. (2-tailed)
Pair 1	Pre Op IOP (in mmHg)	16.55	1.953	0.000
	Post Op IOP at D14 ( (in mmHg)	15.11	1.755	
Pair 2	Pre Op IOP (in mmHg)	16.55	1.953	0.000
	Post Op IOP at D28 ( (in mmHg)	15.04	1.800	
Pair 3	Post Op IOP at D14 ( (in mmHg)	15.11	1.755	0.005
	Post Op IOP at D28 ( (in mmHg)	15.04	1.800	

Table 2. Showing IOP Values at Different Times and Their Comparison by Paired-t test. ( $p < 0.05$ )

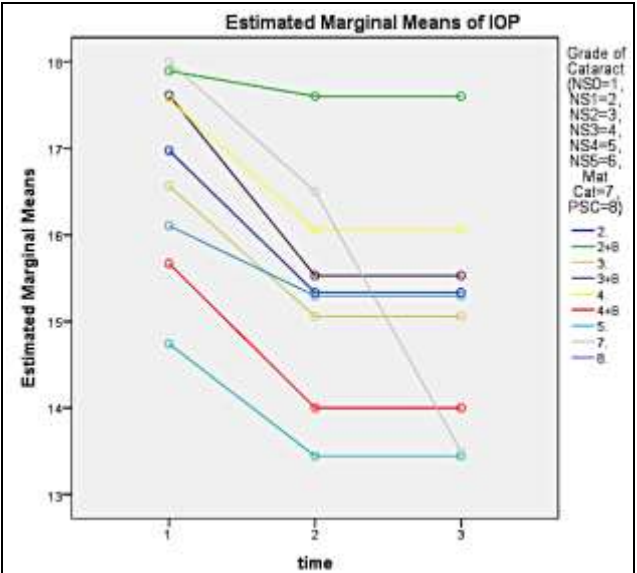


Figure 4. Mean IOP and Their Reduction Plots According to Type of Cataracts Showing NS Gr V has Lowest Preoperative IOP and Mature Cataracts Having Highest Preoperative IOP with Significant Reduction in IOP in all the Groups with Highest Fall of IOP after Cataract Surgery in Eyes with Mature Cataract (Sig: 0.000) ( $p < 0.05$ )

426 eyes were studied of 396 patients and mean age was found to be 54.49 years and their distribution follows the normal curve. Among the patients 64.3% were male ( $n = 274$ ) and 8.2% ( $n = 35$ ) had traumatic cataract. 1.2% ( $n = 5$ ) had type I DM whereas 3.5% had type II DM. Most common type of cataract found was Nuclear Sclerosis Grade III ( $n = 85$ , 19.9%) followed by Nuclear Sclerosis Grade II ( $n = 70$ , 16.4%) and NSII with posterior subcapsular cataract ( $n = 66$ , 15.5%). Mean preoperative IOP was 16.55 ( $\pm 1.953$ )

mmHg. Mean postoperative IOP on day 14 and day 28 were 15.11 ( $\pm 1.755$ ) mmHg and 15.04 ( $\pm 1.800$ ) mmHg respectively (All plots are following the normal distributions). Paired-t test was applied to test the significance between the IOP and it was found that statistical significant ( $p < 0.05$ ) reduction of IOP after cataract surgery after 2 weeks. When IOP after 4 weeks was compared with the IOP after 2 weeks, significant reduction ( $p < 0.05$ ) of IOP was noted. Changes of IOP with time was compared between different groups where it was found that eyes with traumatic cataracts were having IOP significantly higher than non-traumatic group and postoperative IOP was also significantly higher in nontraumatic group ( $p < 0.05$ ). Here proportionate IOP has been found i.e. after cataract surgery, IOP is at proportionate level with pre-operative IOP and it is noted in almost every type of cataract except mature cataract.

## DISCUSSION

The concurrence of glaucoma and cataracts in old age, coupled with the fact that the only known modifiable risk factor in glaucoma management is IOP, has heightened the interest in the effect of cataract surgery on IOP. Here in this study, after glaucoma screening, examination for gradation of cataract were done and phacoemulsification surgery with PCIOL implantation performed in 426 eyes. Follow up IOP were measured at post-operative day 14 and 28. IOP changes according to different parameters were studied accordingly. As cataract surgery is most commonly performed surgery in ophthalmology, so an additional effect on IOP control is always beneficial for the patient especially in elder age group.

Here, in this study, 426 eyes (M:F=1.8:1) were evaluated before and after cataract surgery with PCIOL implantation for IOP changes. The mean age was Mean age 54.49 year ( $\pm$ ) 6.975 year and it was normally distributed. 8.2% (n=35) were having traumatic cataract attributed to referral in tertiary care centre whereas 1.2% (n=5) were having type I DM and 3.5% had type II DM. Most common type of cataract found was Nuclear Sclerosis Grade III (n=85, 19.9%) followed by Nuclear Sclerosis Grade II (n=70, 16.4%). Mean pre-operative IOP was 16.55 mmHg ( $\pm$ ) 1.953 mmHg. The follow up mean IOP was 15.11 mmHg ( $\pm$ ) 1.755 mmHg and 15.04 mmHg ( $\pm$ ) 1.800 mmHg respectively at 14<sup>th</sup> and 28<sup>th</sup> post-operative day. Paired-t test was done to test the significance between the IOP and statistically significant ( $p < 0.05$ ) reduction of IOP was found 2 weeks after cataract surgery. When IOP after 4 weeks was compared with the IOP after 2 weeks, significant reduction ( $p < 0.05$ ) of IOP was also noted.

Mean IOP and their reduction plots according to history of DM showed significantly high IOP in type I DM than other and significant reduction in non-Diabetic groups ( $p < 0.05$ ) and significant reduction in non-traumatic cataracts ( $p < 0.05$ ). Mean IOP and their reduction plots according to type of cataracts showed NS Gr V had lowest pre-operative IOP and Mature Cataracts having highest IOP with

significant reduction in IOP in all the groups with highest fall of IOP after cataract surgery in eyes with Mature Cataract ( $p < 0.05$ ).

Kim KS et al<sup>8</sup> conducted a study in 2009 in which a significant decrease in IOP was found after cataract surgery in non-glaucomatous patients which has been reflected here also. Paired-t test shows statistically significant reduction of IOP. Issa Sa et al<sup>9</sup> conducted a study in 2005 and Poley BJ<sup>10</sup> et al in 2009 in which a consistent finding across multiple populations and studies is that, in patients with open angles at baseline, the level of IOP lowering is proportional to the preoperative IOP. That is, patients with a higher preoperative IOP will have a greater IOP-lowering effect from cataract surgery than those who have a preoperative IOP in the normal physiologic range which is also similar to the study conducted here. Thus, cataract surgery seems to be emerging as a good aid to lower the IOP in patients with mild to moderate glaucoma, while avoiding morbidities of traditional glaucoma surgeries.

In the recent past in a review on IOP lowering after cataract surgery, Shrivastava and Singh<sup>11</sup> have claimed that the anterior chamber angle configuration may influence the amount of IOP lowering after cataract surgery. More precisely they suggested that eyes with narrower anterior chamber angles enjoys a greater fall of IOP after cataract surgery than eyes with open angles. All the eyes in our study had gonioscopically open angles at the baseline visit, so the IOP lowering observed in our study were not likely to be due to the conversion in the angle architecture. Van Buskirk EM in another study on post-mortem human eyes, demonstrated an association between increased facility of aqueous outflow with increased tension on the lens zonule.<sup>12</sup> Cataract surgery with PCIOL implantation in the capsular bag may increase mechanical tension on the zonule which widens trabecular spaces and decrease aqueous outflow resistance. Similar to the latter study, studies by Meyer et al<sup>13</sup> and Kee and Moon<sup>14</sup> demonstrated increased outflow facility after phacoemulsification in eyes without glaucoma. So, the exact mechanism of IOP lowering after cataract surgery is certainly unknown.

## Limitations

Cataract surgery seems to be emerging as a good aid to lower the intraocular pressure in patients with mild to moderate glaucoma. But here, in our study, glaucomatous eyes were not taken into account. Not only open angle cases, angle closure, angle closure suspect, angle closure disease, angle closure glaucoma were all excluded out of the study.

## CONCLUSIONS

As cataract surgery is the most commonly performed surgery in ophthalmology, an additional effect on IOP control is always beneficial for the patient especially in older age group. A significant reduction of IOP is noted after surgery

in all the groups with highest fall of IOP after cataract surgery in eyes with mature cataract. NS Gr V has lowest preoperative IOP and mature cataracts having highest preoperative IOP. A proportionate change of IOP has been found i.e. after cataract surgery, IOP is at proportionate level with pre-operative IOP and it is noted in almost every type of cataract except mature cataract. Mean IOP and their reduction plots according to history of DM shows significantly high preoperative IOP in type I DM than others and significant reduction of IOP occurs in non-diabetic groups.

Cataract surgery to lower IOP may be especially beneficial in developing countries, where close follow up necessitated by traditional glaucoma surgeries is difficult. Nonetheless, cataract surgery seems to be emerging as a good aid to lower the IOP in patients with mild to moderate glaucoma, while avoiding morbidities of traditional glaucoma surgeries. Modern cataract surgery is minimally invasive, producing a mild inflammatory reaction and rapid visual recovery. Furthermore, because it does not involve manipulation of the conjunctiva, subsequent filtration surgery can still be performed.

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