



A STUDY TO DETERMINE THE INTRAOCULAR PRESSURE (IOP) AND ANTERIOR CHAMBER DEPTH CHANGES AFTER MANUAL SMALL INCISION CATARACT SURGERY (MSICS)

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Abstract

Cataract is one of the treatable cause of blindness worldwide. According to World health organization 2021, 94 million people were affected by Cataract. In India according to National Program for Control of Blindness, annual incidence of Cataract blindness is about 3.8 million. Manual small incision cataract surgery is cost effective in developing countries like India.

Objectives- To determine the intraocular pressure changes and anterior chamber depth after Manual small incision cataract surgery (MSICS).

Methods- 50 eyes of 50 patients were included in this study. Detailed anterior segment and posterior segment evaluation was done. After written informed consent patients were evaluated with detailed history, slit lamp examination, Ophthalmoscopy, biometry, IOP measurement using Goldmann Applanation tonometer (GAT), Central corneal thickness (CCT), Endothelial cell count measured using specular microscopy and anterior chamber depth measurement using Anterior segment optical coherence tomography (AS-OCT). The above parameters were measured preoperatively and postoperative day one, week 1, week 4, week 6.

The data obtained was statistically analysed and compiled.

Results- Out of 50 eyes, the mean IOP decrease was found to be 2.16 ± 0.376 mm hg at post operative week 6 which was statistically significant. We also found there was transient rise of IOP on postoperative day one. We compared pre operative and post operative central corneal thickness and anterior chamber depth which was statistically significant.

Conclusion- Cataract surgery, apart from treating cataract does cause reduction in IOP and also deepens the anterior chamber. This study stresses on to preserve endothelial cell loss to have better post operative cornea.

Keywords: Cataract, Intraocular pressure, MSICS, Anterior chamber depth.

Introduction

Cataract is one of the leading causes of preventable blindness in the world. According to WHO 94 million people were affected by Cataract. According to Directorate General of health services of India 62.6% blindness is due to cataract.⁽¹⁾

Manual small incision cataract surgery is cost effective in developing countries like India and popular due to its, easier learning curve, lesser dependence on expensive technology.

Intraocular pressure (IOP) is determined by the balance between the rate of aqueous production and its outflow, the latter in turn is related to the resistance encountered in the trabeculum and the level of episcleral venous pressure.⁽²⁾ Factors affecting IOP are Age, sex, systemic comorbidities, refractive error such as myopia, grade of cataract and postoperative complications such as corneal edema, postoperative uveitis etc.⁽³⁾ Goldmann applanation tonometer is the gold standard to measure the IOP clinically. A transient rise in intraocular pressure after cataract surgery has been well established.

The rise is due to obstruction of trabecular meshwork by viscoelastic material and lenticular debris or by trabeculitis. Rise in intraocular pressure maybe due to anterior chamber reaction, in steroid responders, corneal edema etc. If rise in intraocular pressure left untreated, uncontrolled IOP may result in glaucomatous optic atrophy, anterior ischaemic optic neuropathy. Cataract surgery may alter intraocular pressure postoperatively. Several studies shows there will changes which include increased IOP, decreased IOP, and even hypotony.^(4,5)

Central corneal thickness also plays direct role in underestimating or overestimating IOP. Central corneal thickness (CCT) is known to affect the accuracy of intraocular pressure (IOP) measurement when combined with applanation tonometer. A thicker cornea requires greater force to applanate and, conversely, a thinner cornea is more easily flattened. A thin cornea is a significant risk factor for the development of glaucoma.

Anterior chamber depth(ACD) is also gradually compromised with age due to increase in size of the natural crystalline lens resulting from senile changes. Several studies suggest that there is significant IOP reduction in normal population after cataract extraction with or without posterior chamber intraocular lens implantation. It attributes for long term control of IOP, widening of anterior chamber angle causing its deepening after removal of cataract.

The causes for decreased IOP after cataract surgery include hyposecretion of the aqueous humour secondary to ciliary body irritation. Traction on the ciliary body due to fibrosis and contraction of the posterior lens capsule after cataract surgery also causes hyposecretion of the aqueous. Increased prostaglandin secretion after cataract surgery increases the uveoscleral outflow. The irrigation during surgery flushes the trabeculum and decreases the outflow resistance, increasing the aqueous outflow. Widening of the anterior chamber (AC) angle and increased ACD following cataract extraction also improve the aqueous outflow facility.⁽⁶⁾

The study aims to identify the IOP changes pattern after uneventful manual SICS, to evaluate the Central corneal thickness and Anterior chamber depth changes after SICS.

Methodology

Source Of Data:

Patients attending the Out patient department and inpatients at tertiary care centre, Bangalore

Methods of collection of data :

Study design: Prospective interventional study.

Study period: Nov 2021-May 2024

Place of study: Tertiary care centre, Bangalore.

Inclusion Criteria:

1. Patients willing to give informed consent.
2. Patients who underwent Small incision cataract surgery.
3. Uncomplicated cataract surgeries without any adjunctive procedures.

Exclusion criteria:

1. Patients not willing to give informed consent.
2. History of trabeculectomy or any other intraocular surgeries.
3. History of ocular trauma.
4. Contact lens use.
5. Primary angle closure attacks and suspect and POAG.
6. Pseudoexfoliative glaucoma.
7. Patients who underwent phacoemulsification.
8. Patients on antiglaucoma medications.

Methodology:

After obtaining approval and clearance from institutional ethics committee, the patients fulfilling the inclusion criteria will be enrolled for the study after obtaining the informed consent.

50 cases including both sexes of both presenile and age related cataract included from tertiary care centre, Bangalore.

Patients has been examined in the following procedure:-

Detailed history was taken, visual acuity recording by snellen's vision chart, examination of anterior chamber for type of cataract with nuclear sclerosis grading based on lens opacities classification system, intraocular pressure measured by Goldmann Applanation tonometer, 4 mirror gonioscope to access angle structures, posterior segment evaluation by 78D/90D or indirect ophthalmoscope, central corneal thickness and endothelial cell count measured by specular microscopy, Anterior chamber depth measured using Anterior segment optical coherence tomography.

Preoperatively, intra ocular pressure was measured, 1 day prior to surgery an antibiotic drop is instilled 6 times a day. Then manual small incision cataract surgery was performed. Postoperatively topical therapy of antibiotic steroid combination in form of eye drops given for 6 weeks. Visual acuity, examination of anterior chamber, intraocular pressure, central corneal thickness and endothelial cell count measured at Preoperative day, post op day one, 1st week, 4th week, 6th week. Anterior chamber depth was measured one day prior to surgery and on postoperative 6th week.

Assesment Tools-

1. Goldmann applanation tonometer.
2. Indirect ophthalmoscope/78 D/90 D lens.
3. 4 mirror gonioscopy.
4. Specular microscopy.
5. Anterior segment OCT.

Outcome Measures-

1. Patients will be followed at post op day one, 1st week, 4th week, 6th week.
2. Efficacy parameters-best corrected visual acuity, intraocular pressure measured at each visit.

Statistical Analysis

SPSS (Statistical Package for Social Sciences) version 20. (IBM SPASS statistics [IBM corp. released 2011] was used to perform the statistical analysis

- Data was entered in the excel spread sheet.
- Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables.
- Inferential statistics like
- Chi-square test was applied for qualitative variables.
- The level of significance is set at 5%.

Results

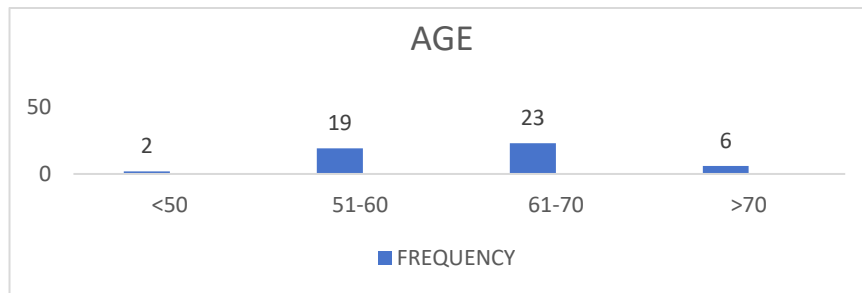
Table 1: Mean Age Distribution Of The Subjects

	Number	Min	Max	Mean	S.D
AGE	50	46	75	62.44	7.290

In this study we enrolled a total of 50 patients who are fit for cataract surgery(MSICS) total mean age 62.44 +7.290.

Table 2: Distribution Of The Subjects Based On Age

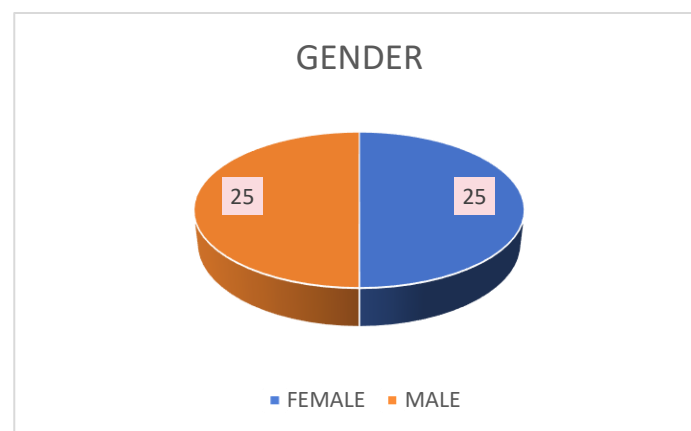
AGE	Frequency	Percent
< 50 yrs	2	4.0
51 to 60 yrs	19	38.0
61 to 70 yrs	23	46.0
> 70 yrs	6	12.0
TOTAL	50	100.0



In this study majority of subjects were between 61 to 70 years followed by 51 to 60 years, >70 years, <50 years.

Table 3: Distribution Of The Subjects Based On Gender.

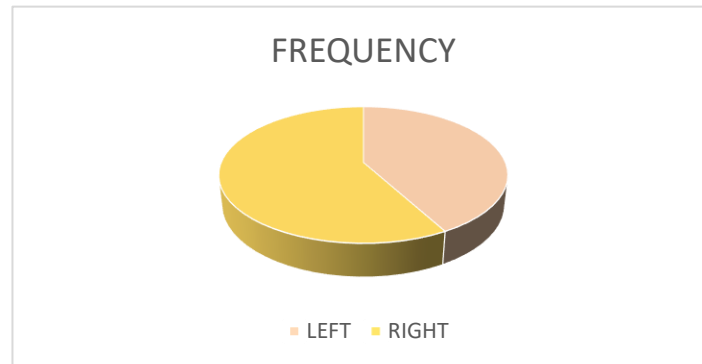
GENDER	FREQUENCY	PERCENTAGE
FEMALES	25	50
MALES	25	50
TOTAL	25	100



In our study 50%(n=25) were males and 50%(n=25).

Table 4: Distribution Of The Subjects Based On Side Of Eye

Side of eye	Frequency	Percent
LEFT	21	42.0
RIGHT	29	58.0
Total	50	100.0



In our study 43%(n=21) were left eyes and 58%(n=29) were right eyes.

Table 5: Distribution Of The Subjects Based On Cataract Grading (Locs Classification Iii)[3]

CATARACT GRADING	FREQUENCY	PERCENTAGE
NC1 P2	3	6.0
NC1 P2 C2	1	2.0
NC2 C2	3	6.0
NC2 P2	14	28
NC2 P2 C2	2	4.0
NC3	1	2.0
NC3 C2	4	8.0
NC3 P2	7	14.0
NC4	7	14.0
NC4 C2	5	10.0
NC4 P2	3	6.0
Total	50	100.0

In our present study we divided the study groups based on lens cataract grading.

Table 6: Comparson Of The Iop At Different Time Intervals Using Repeated Measures Anova

IOP	N	Minimum	Maximum	Mean	S.D	p value
Baseline	50	12	22	16.56	2.589	0.00*
POD 1	50	12	22	16.80	2.799	
1 week	50	12	20	15.28	2.241	
4th week	50	12	18	14.68	2.272	
6th week	50	12	18	14.40	2.213	

*significant

In present study we have compared change in intraocular pressure in 50 eyes that are undergoing cataract surgery(manual SICS).

The mean intraocular pressure was calculated at baseline(preoperative), post op day 1, post op week 1, post op week 4, post op week 6.

Mean Baseline IOP of 50 patients is 16.56±2.589 mm Hg

Mean IOP at post op day 1 is 16.80±2.799 mm Hg.

Mean IOP at post op week 1 is 15.28±2.241 mm Hg.

Mean IOP at post op week 4 is 14.68±2.272 mm Hg.

Mean IOP at post op week 6 is 14.40±2.213 mm Hg.

Table 7: Comparison of IOP, CCT, ECC Between Two Time Intervals Using Post- Hoc Bonferroni Test

TIME INTERVAL		IOP		CCT		ECC	
		MEAN DIFFERENCE	P VALUE	MEAN DIFFERENCE	P VALUE	MEAN DIFFERENCE	P VALUE
BASELINE	POD1	-0.24	1.00	-23.56	0.00	47.30	0.00
	1 WEEK	1.28	0.00	-26.26	0.00	62.14	0.00
	4WEEK	1.88	0.00	-29.90	0.00	75.04	0.00
	6WEEK	2.16	0.00	-31.14	0.00	79.86	0.00
POD1	1 WEEK	1.52	0.00	-2.70	1.00	14.84	0.01
	4WEEK	2.12	0.00	-6.34	0.03	27.74	0.00
	6WEEK	2.40	0.00	-7.58	0.02	32.56	0.00
1 WEEK	4WEEK	0.60	0.00	-3.64	0.00	12.90	0.00
	6WEEK	0.88	0.00	-4.88	0.00	17.72	0.00
4 WEEK	6WEEK	0.28	0.07	-1.24	0.50	4.82	0.45

In this study we found that there was statistical significant change in IOP CCT, ECC levels in baseline IOP to postoperative groups.

Table 8: Distribution Of The Subjects Based On Iop At Different Time Intervals

IOP	Baseline		POD 1		1 week		4th week		6th week	
	N	%	N	%	N	%	N	%	N	%
< 15	14	28.0	13	26.0	24	48.0	29	58.0	30	60.0
15 to 19	26	52.0	24	48.0	23	46.0	21	42.0	20	40.0
20 to 23	10	20.0	13	26.0	3	6.0	0	0.0	0	0.0
Total	50	100.0	50	100.0	50	100.0	50	100.0	50	100.0

In present study we have divided IOP in three groups i.e

<15 mm Hg, 15-19 mm Hg and 19-23 mm Hg.

At 6th week 60% patients had less than IOP of 15mm Hg compared to baseline 28% patients had less than IOP of 15 mm Hg.

At baseline 52% patients had IOP between 15-19 mm Hg compared to 40% at 6th week. At baseline 20% patients had IOP BETWEEN 20-23mm Hg compared to 0% at 6th week.

Table 9-Comparison Of Acd Pre Op And Post Op Acd At 6 Weeks

ACD	MEAN SD	P VALUE
PREOP	3.24	0.41
POST OP	3.49	0.34

In this study mean PRE-OP Anterior chamber depth of eye selected for cataract surgery is 3.24 ± 0.41 whereas POST-OP after cataract surgery was 3.49 ± 0.34 which was statistically significant ($p=0.002$).

**Table 10-Comparison Of The Iop At Different Time Intervals Based On Cataract Grading
Using Repeated Measures Anova**

CATARACT GRADING	IOP- time intervals	N	Mini mum	Maxim um	Mean	S.D	p value
NC1 P2	Baseline	3	12	16	14.00	2.000	0.423
	6th week	3	12	16	13.33	2.309	
NC1 P2 C2	Baseline	1	18	18	18.00		-
	6th week	1	16	16	16.00		
NC2 C2	Baseline	3	14	20	17.33	3.055	0.033*
	6th week	3	12	16	14.00	2.000	
NC2 P2	Baseline	14	12	20	15.86	2.282	0.00*
	6th week	14	12	18	14.00	2.075	
NC2 P2 C2	Baseline	2	16	16	16.00	0.000	0.25
	6th week	2	12	14	13.00	1.414	
NC3	Baseline	1	16	16	16.00		-
	6th week	1	14	14	14.00		
NC3 C2	Baseline	4	16	22	19.50	2.517	0.053
	6th week	4	14	18	16.00	1.633	
NC3 P2	Baseline	7	12	18	14.86	2.268	0.035*
	6th week	7	12	18	13.43	2.507	
NC4	Baseline	7	16	20	17.14	1.574	0.003*
	6th week	7	12	18	15.14	2.545	
NC4 C2	Baseline	5	14	22	18.00	3.162	0.005*
	6th week	5	12	18	15.60	2.608	
NC4 P2	Baseline	3	14	20	18.00	3.464	0.018*
	6th week	3	12	16	14.67	2.309	

*significant

Perfomed repeated measure ANOVA to find significance level between Baseline IOP and post operative IOP week 6 after manual SICS in NC1 P2, NC2 P2, NC4, NC4 C2, NC4 P2 grading of cataract.

Discussion-

In our prospective interventional study, 50 eyes of 50 patients were included, of which 25 were males and 25 were females. Mean age of the study population was 62.44 ± 7.290 . Intraocular pressure was measured using Goldmann Applanation tonometry preoperative, post operative day one, 1st week, 4th week and 6th week. A single surgeon performed manual small incision cataract surgery with implantation of rigid posterior chamber IOL.

So many Research works on relation between cataract surgery (phacoemulsification) and intraocular pressure has been done. In developing countries such as India, manual small incision cataract surgery is popular, hence we did study on intraocular pressure changes after MSICS.

The study was aimed at evaluating intraocular pressure pre and post cataract surgery. The study included 50 eyes of 50 patients who underwent uneventful manual small incision cataract surgery. In our study we also considered central corneal thickness, anterior chamber depth into the consideration.

Out of 50 patients enrolled in my patients 25 were males and 25 were females. The mean IOP at baseline calculated preoperatively was 16.56 ± 2.589 , postoperative day 1 was 16.80 ± 2.799 , postoperative week 1 was 15.28 ± 2.241 , postoperative week 4 was 14.68 ± 2.272 , postoperative week 6 was 14.40 ± 2.213 . These values were statistically significant.

Intergroup comparison done to determine change in IOP among different post operative follow ups. There was statistically significant noted in decrease in IOP when baseline was compared with post op week 1, week 4 and week 6.

In our present study, we did comparison of IOP, CCT between time intervals. There was statistically significant noted when baseline was compared with postoperative day one, week 1, week 4 and week 6.

In our study, we find out the percentage of number of patients who have decline of IOP from baseline IOP to postoperative week 6 among 50 eyes.

We have divided the eyes in three groups based on baseline IOP <15 mmHg, 15 to 19 mmHg, 20 to 23 mmHg of IOP.

At baseline, 52% patients had IOP of 15 to 19 mmHg compared to 40% patients at 6th week. At postoperative 6th week 60% patients had IOP of <15 mmHg compared to 28% patients at baseline IOP.

At baseline, 20% patients had IOP of 20-23 mmHg of IOP compared to 0% patients at 6th week.

In this study mean PRE-OP Anterior chamber depth of eye selected for cataract surgery is 3.24 ± 0.41 whereas POST-OP after cataract surgery was 3.49 ± 0.34 Which was statistically significant ($p=0.002$)

A prospective study conducted by Jacob JM et al. at Dr SMCSI collage, Kerala on 50 eyes,

The mean preoperative IOP was 15.16 mm Hg,

The mean one week postoperative IOP was 14.08 mmHg,

The mean postoperative IOP at three weeks was 13.68 mm Hg, The mean three months postoperative IOP was 13.12 mmHg. The final mean reduction in IOP postoperative at 3 months was 2.040 mm Hg. They concluded that there is significant reduction in IOP after manual SICS. In our study the mean preoperative IOP was 16.56 ± 2.589 , postoperative day 1 was 16.80 ± 2.799 , postoperative week 1 was 15.28 ± 2.241 , postoperative week 4 was 14.68 ± 2.272 , postoperative week 6 was 14.40 ± 2.213 which is in accordance with the above study.⁽¹⁾

A Randomized controlled trial conducted at Aravind eye hospital, Pondicherry by Sengupta S, et al. on 500 eyes. Patients underwent phacoemulsification or MSICS after a 1:1 randomization and allocation code. Results were similar IOP reduction was observed after phaco-emulsification(2.7 ± 2.9 mm Hg) and MSICS($2.6 \pm$ mm Hg). They concluded that both surgeries led to significant and similar IOP reductions 6 months after surgery.⁽²⁾

Major limitation of the study is small sample size which limits the statistical comparison between the groups. Long term effect beyond 6 weeks is not studied in our study.

Conclusion- Cataract surgery causes reduction in IOP and also deepens the anterior chamber which is very useful in narrow and closed angles. This study stresses on to preserve endothelial cell loss to have better post-operative cornea.

References

1. Jacob MJ, Jacob AD, Goudino S. The effect of manual small incision cataract surgery in the intraocular pressure a prospective study in the south kerala. *Indian J Clin Exp ophthalmol*. 2018;4(3):409-12.
2. Sengupta S, Venkatesh R, Krishnamurthy P, Nath M, Mashruwala A, Ramulu PY et al. Intraocular pressure reduction after phacoemulsification versus manual small- incision cataract surgery: a randomized controlled trial. *Ophthalmol*. 2016 Aug 1;123(8):1695-703.
3. Chylack LT, Wolfe JK, Singer DM, Leske MC, Bullimore MA, Bailey IL et al. The lens opacities classification system III. *Archives of ophthalmology*. 1993 Jun 1;111(6):831-36.
4. Schwenn O, Dick HB, Krummenauer F, Krist R, Pfeiffer N. Intraocular pressure after small incision cataract surgery: temporal sclerocorneal versus clear corneal incision. *J Cataract Refract Surg*. 2001 Mar 1;27(3):421-5.
5. Wang N, Chintala SK, Fini ME, Schuman JS. Ultrasound activates the TM ELAM- 1/IL-1/NF- κ B response: a potential mechanism for intraocular pressure reduction after phacoemulsification. *Investigative ophthalmology & visual science*. 2003 May 1;44(5):1977-81.
6. Coban-Karatas M, Sizmaz S, Altan-Yaycioglu R, Canan H, Akova YA. Risk factors for intraocular pressure rise following phacoemulsification. *Indian J.ophthalmol*. 2013 Mar;61(3):115.
7. Varma R, Hwang LJ, Grunden JW, Bean GW. Inter-visit intraocular pressure range: an alternative parameter for assessing intraocular pressure control in clinical trials. *American J. ophthalmology*. 2008 Feb 1;145(2):336-42.
8. Steuhl KP, Marahrens P, Frohn C, Frohn A. Intraocular pressure and anterior chamber depth before and after extracapsular cataract extraction with posterior chamber lens implantation. *Ophthalmic Surgery, Lasers and Imaging Retina*. 1992 Apr 1;23(4):233-7.
9. Wishart PK, Atkinson PL. Extracapsular cataract extraction and posterior chamber lens implantation in patients with primary chronic angle-closure glaucoma: effect on intraocular pressure control. *Eye*. 1989 Nov;3(6):706-12.
10. Poley BJ, Lindstrom RL, Samuelson TW, Schulze Jr R. Intraocular pressure reduction after phacoemulsification with intraocular lens implantation in glaucomatous and nonglaucomatous eyes: evaluation of a causal relationship between the natural lens and open-angle glaucoma. *J Cataract Refract Surg*. 2009 Nov 1;35(11):1946-55.
11. Shin HC, Subrayan V, Tajunisah I. Changes in anterior chamber depth and intraocular pressure after phacoemulsification in eyes with occludable angles. *J Cataract Refract Surg*. 2010 Aug 1;36(8):1289-95.