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COMPARISON OF POSTERIOR CAPSULE OPACIFICATION BETWEEN HYDROPHILIC AND HYDROPHOBIC SINGLE-PIECE ACRYLIC INTRAOCULAR LENSES AFTER CATARACT EXTRACTION IN PATIENTS UNDERGOING PHACOEMULSIFICATION

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ABSTRACT Cataract is the commonest cause of preventable and curable blindness. Phacoemulsification with IOL implantation is the surgical technique of choice for treatment of cataract. Posterior capsule opacification is the most common late complication of surgery. IOL material has modest effect on opacification rates:hydrogel IOLs have the highest rate followed by PMMA,then silicon and hydrophobic acrylic material with the lowest rate. The present study was done to know the outcome of phacoemulsification surgery in cataract and to compare posterior capsule opacification rates after implantating hydrophilic and hydrophobic single piece acrylic intraocular lenses.PCO rate was 16% in hydrophilic acrylic intraocular lenses as compared to 4% in hydrophobic acrylic intraocular lenses 6 months after surgery. The advent of newer lens materials like hydrophobic lenses can reduce the late postoperative complication PCO significantly and help in achieving emmetropic vision.

KEYWORDS : Posterior Capsule Opacification,cataract,intraocular Lenses.

INTRODUCTION

Cataract is clouding of the lens in the eye leading to a decrease in vision. It is a condition in which opacification appears in an otherwise transparent lens and this opacification makes the person visually handicapped.

Cataract is the commonest cause of preventable and curable blindness.(1)Age-related cataracts are responsible for 51% of world blindness, about 20 million people.(2)Globally, cataracts cause moderate to severe disability in 53.8 million (2004), 52.2 million of whom are in low and middle income countries.(3) South East Asia which includes India has a population of more than one fourth of the total globe, and one third of the world's blind people live in this region and the majority of cases of blindness are attributable to cataract.(4)The cataract surgery has evolved from couching to phacoemulsification. The recent advances in cataract surgery have reduced the incidence of corneal complications. With the improvement in surgical techniques and development of new technology, the recovery of visual function has considerably improved. (5)

In 1967, Charles Kelman introduced phacoemulsification, a technique that used ultrasonic waves to emulsify the nucleus of the crystalline lens in order to remove the cataracts without a large incision.(6)

The technique of cataract extraction has changed drastically in recent years due to the introduction of operating microscope and intraocular lens implant. However, the modern trend is in favour of extracapsular lens extraction along with intraocular lens implantation. This reduces the incidence of vitreous loss to the minimum with superior visual results.

Phacoemulsification, since its inception has emerged to be one of the great techniques and slowly as its popularity increased, has been adopted by a wider group of surgeons.

Phacoemulsification is a sophisticated technique of extracapsular cataract extraction and now is the most popular method worldwide and has virtually replaced all other techniques. This operation consists of the application of ultrasonic vibrations to fragment the nucleus of the cataract and to emulsify these fragments.

The modern surgical techniques employed for cataract surgery are safe with few complications. The most common late complication of cataract surgery by means of ECCE or phacoemulsification is posterior capsule opacification (PCO). Capsular opacification stems from the continued viability of lens epithelial cells that remain after removal of the nucleus and cortex. Opaque secondary membranes are formed by proliferating lens epithelial cells, fibroblastic metaplasia, and collagen deposition. If the epithelial cells migrate across the anterior or posterior capsule, they may cause capsular wrinkling and opacification. Significantly, the lens epithelial cells are capable of undergoing metaplasia with conversion to myofibroblasts. These cells can produce a matrix of fibrous and basement membrane collagen. Contraction of this collagen matrix will cause wrinkles in the posterior capsule, with resultant distortion of vision and glare.(7)

The reported incidence of posterior capsule opacification varies widely and seemsto be diminishing with current IOL design and placement. Factors thought to influence this rate include the age of the patient, history of intraocular inflammation, presence of exfoliation syndrome, size of the capsulorrhexis, quality of the cortical cleanup, capsular fixation of the implant, design of the lens implant (specifically a reduction in incidence with posterior convex or a truncated square-edge optic design), modification of the lens surface, and time elapsed since surgery. (8,9)

The IOL material also has a modest effect on opacification rates: hydrogel IOLs have the highest rate, followed by PMMA, then silicone and hydrophobic acrylic material with the lowest rate.(10)

The present study was done to know the outcome of the phacoemulsification surgery in cataract and to compare the posterior capsule opacification rates after implanting hydrophilic and hydrophobic single piece acrylic intraocular lenses.

AIMS AND OBJECTIVES

1. To study posterior capsular opacification after implantation of hydrophilic and hydrophobic - single piece acrylic intraocular lenses
2. To know the outcome of cataract surgery after implantation of IOLs with these two materials.

MATERIALS AND METHODS

100 patients were prospectively recruited which presented to outpatient department of Regional Institute of Ophthalmology, Government Medical College, Amritsar who satisfied the criteria after explaining the nature of study and obtaining the written consent. After taking written informed consent, all patients were subjected to complete ophthalmic examination on 1st post-operative day, 7th post –operative day,1 month and 3 month and 6 months after surgery.
Patients were divided in 2 groups

Group 1–Patients undergoing phacoemulsification with hydrophilic single piece intraocular lens implantation.

Group 2-undergoing phacoemulsification with hydrophobic single piece intraocular lens implantation.

Inclusion criteria

1. Patients with senile cataract irrespective of sex.

Exclusion criteria for the study were the

1. Eyes with significant corneal opacity.
2. Trauma
3. Glaucoma
4. Uveitis
5. Fuch's endothelial dystrophy
6. Other abnormalities that could cause significant endothelial cell impairment independent of surgeries
7. Eyes with small pupils that require iris retractors
8. Eyes with intraoperative complications like post capsular rupture or post-operative complications.

Material used:-

1.Hydrophilic single piece acrylic intraocular lens
2.Hydrophobic single piece acrylic intraocular lens

Procedure:-

All patients selected for cataract surgery underwent Phacoemulsification under local anaesthesia with implantation of Intraocular Lens.

Follow-up was done on 1st day, 7th day, 1 month, 3 months and 6 months.

The results were compared in relation to visual outcome, any post-operative complication and posterior capsular opacification arising thereafter in both the groups.

OBSERVATIONS

The patients were divided into two groups (Group 1 and Group 2), each consisting of 50 cases.

Group 1: Patients in which hydrophilic single-piece acrylic intraocular lens was implanted

Group 2: Patients in which hydrophobic single-piece acrylic intraocular lens was implanted

The observations were compared statistically and tabulated as follows.

TABLE 1
AGE WISE DISTRIBUTION IN GROUP1 AND GROUP 2

Age group (years)	Group 1		Group 2	
	No.	%age	No.	%age
21-40	4	8.0	1	2.0
41-60	22	44.0	29	58.0
61-80	24	48.0	17	34.0
Above 80	0	0	3	6.0
Total	50	100.00	50	100.00
Mean	58.54±11.65		60.16±9.78	
p-value	0.454			

Table 1 shows age wise distribution in the two groups. In group 1, out of a total of 50 cases, 4 (8%) were in age group of 21-40 years, 22 (44%) were in age group of 41-60 years and 24 (48%) were in the age group of 61-80 years. No patient was above the age of 80 years in this group.

In group 2, out of a total of 50 cases, 1 (2%) was in the age group of 21-40 years, 29 (58%) were in the age group of 41-60 years, 17 (34%) were in the age group of 61-80 years and 3 (6%) were in the age group of above 80 years.

Out of the total of 100 cases in Group 1 and 2, the maximum 51 (51%) cases were in the age group of 41-60 years and 41 (41%) were in the age group of 61-80 .

TABLE 2
MEAN AGE IN GROUP 1 AND GROUP 2

S No	Mean Age	SD	P Value	Significance
Group 1	58.54	11.65	0.454	Non Significant
Group 2	60.16	9.78		

Table 2 above shows the mean age in Group 1 and Group 2. The mean age in Group 1 was 58.54±11.65 and in Group 2 was 60.16±9.78 (p value > 0.05).

The age factor was found to be statistically insignificant

TABLE 3
SEX DISTRIBUTION IN GROUP1 AND GROUP 2

Sex	Group 1		Group 2	
	No of Cases	%age	No of Cases	%age
Males	23	46	31	62
Females	27	54	19	38
Total	50	100	50	100
X2	2.58			
Df	1			
p-value	0.108			

Table 3 shows the sex distribution in Group 1 and Group 2. Out of the total 100 cases, 54 (54%) were males and 46 (46%) were females. In Group 1, 23 (46%) were males and 27 (54%) were females. In group 2, 31 (62%) were males and 19 (38%) were females.

The sex distribution was found to be statistically insignificantT h e r e were no statistically significant differences in demographic variables i.e. age and sex between the two groups. (p value > 0.05)

TABLE 4
VISUAL ACUITY AT PRESENTATION

	Group 1		Group 2	
Visual Acuity	Number	%age	Number	%age
6/12	1	2	1	2
6/18	3	6	1	2
6/24	4	8	14	28
6/36	19	38	22	44
6/60	12	24	12	24
3/60	7	14	0	0
FC at 1m	3	6	0	0
PL +ve, PR accurate	1	2	0	0
Total	50	100	50	100

Out of the total 100 cases, the maximum 31 (31%) cases presented with VA of 6/36 followed by 24 (24%) cases with VA of 6/60 and 18 (18%) cases with VA of 6/24.

TABLE 5
CLASSIFICATION OF NUCLEAR OPALESCENCE (NO/NC) AS PER LOCS III

	Number of Patients					
Age Group (Years)	NO1	NO2	NO3	NO4	NO5	Total
21-40	02	0	0	0	0	02
41-60	19	13	07	05	02	46
61-80	08	06	11	04	08	37
Above 80	01	0	01	0	02	04
Total	30	19	19	09	12	89

Of the all grades of nuclear opalescence, the maximum number was seen that of NO1 (30 cases) followed by NO2 and NO3 (19 cases each).

TABLE 6. CLASSIFICATION OF CORTICAL CATARACT (C) AS PER LOCS III

	Number of Patients					
Age Group Years)	C1	C2	C3	C4	C5	Total
21-40	02	01	0	0	01	04
41-60	09	16	09	10	04	48
61-80	01	03	13	15	09	43
Above 80	0	0	01	01	02	04
Total	12	20	23	26	16	99

Of the all grades of Cortical Cataract, the maximum number was seen that of C4 (26 cases) followed by C3 (23 cases) and C2 (20 cases).

TABLE 7
LOCS III CLASSIFICATION OF POSTERIOR SUBCAPSULAR

	Number of Patients					
Age Group (Years)	P1	P2	P3	P4	P5	Total
21-40	0	0	02	02	0	04
41-60	01	10	19	08	0	38
61-80	06	09	06	01	01	23
Above 80	0	0	0	0	01	01
Total	07	19	27	11	02	66

Of the all grades of Posterior Subcapsular Cataract, the maximum number was seen that of P3 (27 cases) followed by P2 (19 cases) and P4 (11 cases).

As listed in Table 5,6 and7, the number of patients with Nuclear Opalescence Cataract were 89, the number of Cortical Cataract patients were 99 and the number of Posterior Subcapsular cataract patients were 66. Hence, the most common cataract in the present study was a mixed one.

IOL IMPLANTED

TABLE 8
TABLE SHOWING THE POWER OF LENS USED

	Type of Lens		
Lens Power	Hydrophilic	Hydrophobic	Total
20.00	10	08	18
20.50	02	02	04
21.00	11	15	26
21.50	06	08	14
22.00	13	09	22
22.50	01	05	06
23.00	07	01	08
23.50	0	02	02
Total	50	50	100

POSTOPERATIVE VISUAL ACUITY ATTAINED

TABLE 9
SHOWING POSTOPERATIVE VISUAL ACUITY ATTAINED IN GROUP A (HYDROPHILIC LENSES)

	1 MONTH	3 MONTH	6 MONTH
6/6	-	11	11
6/9	11	22	22
6/12	22	9	9
6/18	12	6	6
6/24	3	0	0
6/36	2	2	2
6/60	0	0	0
Total	50	50	50

After 1 month postoperatively, no patient achieved 6/6 visual acuity (VA) out of the total 50 patients in whom the hydrophilic acrylic single-piece IOL lens was implanted. A total of 11 patients attained 6/9 VA and 22 patients attained 6/18 VA after 1 month postoperatively.

After 3 months postoperative period, patients with 6/12 and 6/18 VA started having improved VA with 11 patients falling in 6/6 VA group and 22 patients falling in 6/9 VA group. There was no change in the VA after 6 months postoperative period.

TABLE 10
SHOWING POSTOPERATIVE VISUAL ACUITY ATTAINED IN GROUP 2 (HYDROPHOBIC LENSES)

	1 MONTH	3 MONTH	6 MONTH
6/6	0	23	23
6/9	24	22	22
6/12	22	2	2
6/18	2	1	1
6/24	0	0	0
6/36	0	0	0
6/60	2	2	2
Total	50	50	50

In the Group 2, after 1 month postoperative period, no patient had a VA of 6/6 whereas 24 and 22 patients fell into 6/9 VA and 6/12 VA group respectively. After 3 months postoperative period, only 2 patients were in the 6/12 VA group while 23 patients were in the 6/6 VA group. After 6 months postoperative period, 23 patients were in the 6/6 VA group, 22 patients in the 6/9 VA group. There were 2 patients who had 6/60 VA and their vision never improved even after 6 months postoperative period.

TABLE 11
COMPARISON OF POSTOPERATIVE BEST CORRECTED VISUAL ACUITY AT 6 MONTHS IN GROUP 1 AND GROUP 2

Best Corrected Visual Acuity (BCVA)	Percentage of patients (%)	
	Group 1	Group 2
VA ≤ 6/18	3	2
VA > 6/18	47	48
X2	0.211	
Df	1	
P Value	0.646	

The difference in the postoperative best corrected visual acuity at 6 months was not statistically significant (p value > 0.05).

POSTERIOR CAPSULE OPACIFICATION

TABLE 12
POSTERIOR CAPSULE OPACIFICATION AT 1 MONTH POSTOPERATIVE PERIOD IN GROUP 1 AND GROUP 2

Group		Posterior Capsule 1 Month		Total
		Clear	Thin PCO	
A	No.	44	6	50
	%	88.0%	12.0%	100.0%
B	No.	48	2	50
	%	96.0%	4.0%	100.0%
Total	No.	90	10	100
	%	90.0%	10.0%	100.0%

X^2: 2.36; df: 1; p-value: 0.124

At 1 month postoperative period, in Group 1, there were 6 (12%) patients who showed the postoperative complication of posterior capsule opacification (PCO) whereas in comparison, in Group 2, there were only 2 patients who showed PCO at 1 month postoperative period.

TABLE 13
POSTERIOR CAPSULE OPACIFICATION AT 3 MONTH POSTOPERATIVE PERIOD IN GROUP 1 AND GROUP 2

Group		Posterior Capsule 3 Month		Total
		Clear	Thin PCO	
A	No.	42	8	3
	%	84.0%	16.0%	6.0%
B	No.	48	2	1
	%	96.0%	4.0%	2.0%
Total	No.	90	6	4
	%	90.0%	6.0%	4.0%

X^2: 4.00; df: 1; p-value: 0.046

After 3 months postoperative period, the rate of posterior capsular opacification increased in Group 1 and a total of 8 (16%) patients had this complication in comparison to the Group 2 in which the number of patients with PCO remained unchanged with a significant p value (<0.05).

TABLE 14
POSTERIOR CAPSULE OPACIFICATION AT 6 MONTH POSTOPERATIVE PERIOD IN GROUP 1 AND GROUP 2

Group		Posterior Capsule 6 Month		Total
		Clear	Thin PCO	
A	No.	42	8	3
	%	84.0%	16.0%	6.0%
B	No.	48	2	1
	%	96.0%	4.0%	2.0%
Total	No.	90	6	4
	%	90.0%	6.0%	4.0%

X^2: 4.00; df: 1; p-value: 0.046

After 6 months postoperative period, the rates of posterior capsular opacification remain unchanged to the values of 3 months postoperative which were again statistically significant (p value < 0.05)

DISCUSSION

The present study was a randomized prospective study and was conducted after approval from the institutional thesis and ethics committee. A total of 100 cases visiting the Regional Institute of Ophthalmology, Government Medical College, Amritsar were randomly selected and were divided into two groups. 50 cases randomized to group 1 and 50 cases randomized to group 2.

Group 1: Patients in which hydrophilic single-piece acrylic intraocular lens was implanted

Group 2: Patients in which hydrophobic single-piece acrylic intraocular lens was implanted

Grading of the cataract was not taken into consideration in the patient allotment to the both groups. All the patients of both the groups underwent phacoemulsification with foldable posterior chamber intraocular lens implantation by a single surgeon. The cases in which complication occurred during the surgery i.e. posterior capsule rupture, vitreous loss, cortex in the vitreous and after the surgery i.e. leaking incisions and malposition of the intraocular lens were excluded from the study.

In this study,the difference in the mean age in both the groups was statistically not significant (p value > 0.05), hence the two groups were comparable with respect to age distribution.

Out of a total of 100 cases,the sex distribution was found to be statistically insignificant, hence the two groups were comparable with respect to sex distribution.

On presentation in Group 1, there were maximum 19 (38%) cases with VA of 6/36 followed by 12 (24%) cases with VA of 6/60, 7 (14%) cases with VA of 3/60, 4 (8%) cases with VA of 6/24, 3 (6%) cases with VA of 6/18, 3 (6%) cases with VA of finger counting at 1 metre. The least number was 1 (2%) case with visual acuity (VA) of 6/12, and 1 (2%) case with PL +ve and PR accurate.

On presentation in Group 2, there were maximum 22 (44%) cases with VA of 6/36 followed by 14 (28%) cases with VA of 6/24,12 (24%) cases with VA of 6/60 and 1 (2%) case each in the VA category of 6/12 and 6/18,.

Out of the total 100 cases, the maximum 31 (31%) cases presented with VA of 6/36 followed by 24 (24%) cases with VA of 6/60 and 18 (18%) cases with VA of 6/24.

The cataract classification was done by slit-lamp assessment of lens opacities using the Lens Opacities Classification III (LOCS III). As listed in Table 5,6 and 7, the number of patients with nuclear cataract were 89, the number of cortical cataract patients were 99 and the number of posterior subcapsular cataract patients were 66. Hence, the most common cataract in the present study was a mixed oneI n t h e present study, a total of 26 cases were implanted with the IOL power 21.00 out of the total of 100 cases followed by 22 cases who were implanted IOL lens with the power 22.00. Of all the hydrophilic lens used, the maximum number of cases were implanted with the power 22.00. Of all the hydrophobic lenses used, the maximum number of cases were implanted with the power 21.00.

There were no significant intraoperative complications in both the groups. All the patients were examined on slit-lamp postoperatively at different periods and no significant complication was observed in both the groups.

In the present study in Group 1, 47 (94%) cases had postoperative best corrected visual acuity better than 6/18 at six months while in Group 2, 48 (96%) cases had postoperative best corrected visual acuity better than 6/18 after the same period. The difference in the postoperative best corrected visual acuity at 6 months was not statistically significant (p value > 0.05). The results are comparable with many studies in the literature.

In a comparative study of postoperative results after implantation of hydrophilic acrylic and hydrophobic acrylic lenses, Zemaitiene R et al found no significant differences in best corrected visual acuity (BCVA) between the two IOL types at 1-year follow up after surgery.

Heatley CJ et al in an another study of comparison between the hydrophilic and hydrophobic acrylic single piece lenses have also found no significant difference between the best corrected visual acuity at 6 months and 1 year postoperative period.

In the present study, At 1 month postoperative period, in Group 1, there were 6 (12%) patients who showed the postoperative complication of posterior capsule opacification (PCO) whereas in comparison, in Group 2, there were only 2 patients who showed PCO at 1 month postoperative period.

After 3 months postoperative period, the rate of posterior capsular opacification increased in Group 1 and a total of 8 (16%) patients had the complication in comparison to the Group 2 in which the number of patients with PCO remained unchanged. At 6 months postoperative period, the rates of posterior capsular opacification remained at the 3 month postoperative findings.

On comparison between the two lenses, the rate of development of posterior capsular opacification was found to be statically significant.The findings of this study are similar and comparable with the many studies in the literature.

In a meta-analytical comparison study of hydrophobic and hydrophilic lenses in preventing posterior capsular opacification (PCO) after cataract surgery, Zhao Y et al included a total of eleven studies. The overall analysis revealed that in general, PCO scores and the rate of Nd:YAG laser capsulotomy were influenced by intraocular lens biomaterial. The lenses made of hydrophobic biomaterial were overall superior in lowering the PCO score and the Nd:YAG laser capsulotomy rate, but not visual acuity.

Vasavada AR et al did a prospective randomized clinical trial to compare posterior capsule opacification (PCO) 3 years postoperatively in contralateral eyes with a single-piece hydrophobic acrylic and 1 of 2 single-piece hydrophilic acrylic intraocular lenses (IOLs) with different configurations. Their study concluded that posterior capsule opacification was significantly less with the Acrysof hydrophobic acrylic IOL.

An another study by Iwase T et al assessed the posterior capsule opacification (PCO) 2 years after cataract surgery with implantation of a hydrophobic acrylic or single-piece sharp-edged hydrophilicacrylic intraocular lens (IOL). The study concluded the PCO value in thehydrophilicgroup increased significantly with time and was statistically significantly greater than in the hydrophobic group. The study further revealed that the capsulotomy rate was statistically significantly higher in the hydrophilic group than in the hydrophobic group.

A meta-analytical study was done by Li Y et al in which an electronic search was performed using the Pubmed, Embase and Cochrane Library database to study the effect of hydrophobic acrylic verses hydrophilic acrylic intraocular lens on posterior capsule opacification. The study concluded that in comparison to hydrophilic acrylic IOLs, the hydrophobic acrylic IOLs showed superior reduction in rates of

PCO and laser capsulotomy in 2-year follow-up

In order to describe the pathogenesis of postoperative posterior capsule opacification, a study was done by Pelin O et al. The study observed that in terms of material characteristics, posterior capsule opacification occurred more frequently with hydrophilic compared to hydrophobic IOLs because a hydrophilic surface provides a foundation for lens epithelial cell proliferation and migration, whereas a hydrophobic surface adheres tightly to the posterior capsule due to its highly bioadhesive nature.

SUMMARY AND CONCLUSION

The observations made during the study are summarized as under.

1. The mean age of the patients in Group 1 was 58.54 ± 11.65 years and 60.16 ± 9.78 in Group 2 and the difference in the mean age in both the groups was statistically not significant (p value > 0.05).
2. The total number of male and female patients were 54 and 46 respectively.
3. At the time of enrolment, the maximum number of patients were having visual acuity (VA) of 6/36 i.e. 38% followed by VA of 6/60 in 24% of cases.
4. Slit-lamp assessment of the various grades of cataract using LOCS III classification system showed mixed type of cataract in the majority of the cases followed by pure nuclear and cortical cataract.
5. There were no significant intraoperative and postoperative complications in both hydrophilic lens and hydrophobic lens groups.
6. The best corrected visual activity (BCVA) of 6/6 was observed in 11 patients at 6 months in the hydrophilic lens group while it was recorded in 23 patients in the hydrophobic lens group.
7. The majority of the patients gained visual acuity better than 6/18 at 6 months postoperative period in both the groups. It was observed in 94% of the total cases in hydrophilic lens group and in 96% of cases in the hydrophobic lens group. The difference in the postoperative best corrected visual acuity at 6 months in both the groups was not statistically significant.
8. The posterior capsule opacification (PCO) was observed in 12% of the patients in hydrophilic lens group at 1 month postoperative period and in only 4% of the cases in the hydrophobic lens group.
9. The posterior capsule opacification increased to 16% of the patients in the hydrophilic lens group and remain unchanged in the hydrophobic lens group at 3 months postoperative period. This observation remain unchanged at 6 months postoperative period which was statistically significant (p value < 0.05)
10. All patients with posterior capsule opacification underwent Nd:YAG Laser Capsulotomy at 6 months postoperative period and regained visual acuity better than 6/18.

In conclusion, posterior capsule opacification (PCO) is a significant postoperative factor leading to low vision even after implantation of intraocular lens after phacoemulsification cataract surgery. Intraocular lens materials is an important variable in the development of posterior capsule opacification. The advent of newer lens materials like hydrophobic lenses can reduce the postoperative complication significantly and help in achieving the emmetropic vision. Further multiple studies with large sample size are needed to assess the efficacy and impact of different lens materials on postoperative visual outcome after cataract surgery.

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