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Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

A hospital based retrospective comparative study of near vision following cataract surgery by phacoemulsification using hydrophilic monofocal intraocular lens and hydrophobic monofocal yellow intraocular lens

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Abstract

Background: Cataract surgery with intraocular lens (IOL) implantation is the standard treatment for restoring vision. The choice between hydrophilic and hydrophobic monofocal yellow IOLs may influence postoperative near vision outcomes.

Aim and Objectives: To study the efficacy and benefits of hydrophobic yellow IOL over hydrophilic IOL to improve the quality of near vision outcome following cataract surgery by Phacoemulsification.

Materials and Methods: In this retrospective study from Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem during the time period of January 2024 to June 2024, 100 eyes between 40 -55 years of age were with visually significant uncomplicated cataract were taken and divided into two groups that were evenly distributed . 50 eyes with implantation of hydrophilic monofocal IOL (Acryfold) and the other group of 50 eyes with implantation of hydrophobic monofocal yellow IOL (AcrySof IQ). After complete pre-op evaluation, Phacoemulsification surgery was done by the same surgeon and with the implantation of same company monofocal IOLs under topical anaesthesia with 0.5% proparacaine. Post operatively, both the two groups of patients were examined with the same snellen near vision chart with same illumination, same distance (33cm) and in same refraction room during 1st week, 3rd week and 6th week respectively.

Results: There is no difference between the hydrophilic and hydrophobic yellow IOL groups with respect to the dependent variable distant vision at 6th week post operatively. Logistic regression analysis shows that the model as a whole is not significant (Chi square = 2.74, p .254, n = 100). There is a difference between the hydrophilic and hydrophobic yellow IOL groups with respect to the dependent variable of postoperative near vision at 6th week. Logistic regression analysis shows that the model as a whole is significant for near vision (Chi-square = 11.8, p .001, n = 100).

Conclusion: The acrylic hydrophobic material with UV-blocking chromophore-yellow lenses are shown to have better visual outcomes due to dual advantage of blocking blue light at bright illumination, as well as allowing blue light in dim illumination which is required for resetting the biological clock and night vision. Thus, it may show improved near vision status after cataract surgery.

Keywords: Near vision, Monofocal IOL, Hydrophobic yellow IOL, Hydrophilic IOL.

Received: 25-10-2024; **Accepted:** 11-04-2025; **Available Online**: 13-09-2025

1. Introduction

Globally, untreated vision problems such as uncorrected refractive errors and cataracts are the leading causes of low vision and blindness.[1] Due to inadequate near vision correction, around 826 million people have near vision loss.[2] Impaired near vision lowers life quality, whereas improving it enhances productivity at work.[3,4] Monofocal intraocular lenses (IOLs) provide excellent visual acuity (VA), but as the name suggests, it is only for distance vision usually . After IOL implantation, patients can no longer accommodate, thus they necessitate to wear glasses to see distances in focus.

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https://doi.org/10.18231/j.ijceo.v.11.i.3.20

Several studies have reported that near vision is affected due to various factors like IOL movement, IOL placement in the bag, patient age, residual myopic astigmatism, type of astigmatism, corneal multifocality, axial length, high order contrast, and depth of focus with pupillary constriction during accommodation.[5-8] The factors linked to "good near vision" following monofocal IOL implantation may be useful in the planning of a low-cost treatment for presbyopia following cataract surgery.

Depending on the materials used to make IOLs, it is classified into two types - hydrophilic monofocal IOL and hydrophobic monofocal IOL.[9,10] The acrylic hydrophobic material with UV blocking chromophore – yellow lenses are shown to have better visual outcomes in terms of long-term complications like PCO and reduce post-operative visual glares compared to hydrophilic IOLs.[11-13] In this study, we compared the efficacy and benefits of hydrophobic yellow intraocular lens to hydrophilic intraocular lens in improving the near vision outcome following cataract surgery by phacoemulsification. Research on near vision correction with monofocal IOLs is still important, even in the era of multifocal IOLs as its still the cost-effective way in regaining useful vision post-operatively.[14,15]

2. Materials and Methods

2.1. Study setting

The hospital-based retrospective study was conducted in Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka Mission's Research Foundation (DU), Salem. The present study was accepted by the Institutional Ethics Committee (IEC) of Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem, India (IRB Approval letter number – VMKVMC&H/IEC/24/272). Informed consent was taken from all the study participants for cataract surgery from the time period of January 2024 to June 2024.

2.2. Study participants

In this study, 100 senile cataract patients who underwent phacoemulsification with one of the hydrophilic monofocal intraocular lens or hydrophobic monofocal yellow intraocular lens were included.

2.3. Inclusion criteria

1. Patients undergoing cataract surgery between age 40-55 years.
2. Patients undergoing cataract surgery with hydrophilicmonofocal lens and hydrphobic monofocal yellow intraocular lens.

2.4. Exclusion criteria

1. High myopia
2. Squint
3. Corneal pathology
4. Retinal pathology
5. Vitreous pathology
6. Patient going for multifocal lens & iris claw lens
7. Cataract surgeries with pterygium excision
8. IOL in sulcus
9. Traumatic cataract
10. Patients with diabetes mellitus

2.5. Methodology

Patients were divided into two study groups. One group was included 50 patients with implantation of hydrophilic monofocal IOL (Acryfold) and the other group was included 50 patients with implantation of hydrophobic monofocal yellow IOL (AcrySof IQ).

All the patients in both groups were between 40-55 years of age with visually significant uncomplicated cataracts without any ocular comorbidity problems. After complete pre-op evaluation, a surgical procedure of phacoemulsification was carried out. Phacoemulsification surgery was done by the same surgeon and with the implantation of same company monofocal IOLs under topical anaesthesia with 0.5% proparacaine. Post operatively, both the two groups of patients were examined with the same Snellen near vision chart with same illumination, same distance (33 cm) and in same refraction room during 1st week, 3rd week and 6th week respectively.

2.6. Statistical analysis

Data was entered and analysed using SPSS version 25 software. Mean and the standard deviation of the near visual acuity were calculated. Test of significance was carried out by logistic regression analysis and P value < 0.05 was considered statistically significant.

3. Results

This study of one hundred patients was conducted at department of Ophthalmology, in Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem. The patients were divided into two groups of fifty patients each. Group A had acrylic hydrophilic monofocal IOL (Acryfold) implanted and Group B had acrylic hydrophobic monofocal yellow IOL (AcrySof *IQ)* implanted.

The age range of patients in both groups was between 40-55 years (**Table 1**).

Table 1: Distribution of age

		Mean	Std. Deviation
Age	Hydrophilic	48.32	4.24
	Hydrophobic Yellow IOL	48.52	4.66

Table 2 presents the gender distribution of patients who received either hydrophilic or hydrophobic yellow intraocular lenses (IOL). Among the total 100 subjects, 54

were male and 46 were female. The distribution was equal across the two IOL groups, with each group comprising 27 males and 23 females. This indicates that the allocation of hydrophilic and hydrophobic yellow IOLs was balanced in terms of gender, minimizing gender-based bias in outcome evaluation.

Table 2: Distribution of gender

		Hydrophilic/ Hydrophobic Yellow IOL		
		Hydrophilic IOL	Hydrophobic Yellow IOL	Total
Gender	Male	27	27	54
	Female	23	23	46
	Total	50	50	100

The pre-operative distant vision was comparable between the two groups, with the maximum cases falling in the group of 5/60 (38 cases out of 100, i.e. 38%), 6/60 (30 out of 100 cases, i.e. 30%), 6/36 (11 out of 100 cases, i.e. 11%), 6/24(21 out of 100 cases, i.e. 21%) respectively.(**Table 3**)

Table 3: Shows range of preoperative distant visual acuity from 6/60 to 6/18

Pre-op VA for distance	Category	N
	5/60	38
	6/60	30
	6/36	11
	6/24	21
Valid Total	100	100%

Table 4 shows the pre-operative NEAR vision was comparable between the two groups, with the maximum cases falling in the group of N12 (42 cases out of 100, i.e. 42%), N18 (32 out of 100 cases, i.e. 32%), N24 (21 out of 100 cases, i.e. 21%), N36 (5 out of 100 cases, i.e. 5%) respectively.

Table 4: Preoperative near vision

	Category	N
Pre op NV	N12	42
	N18	32
	N24	21
	N36	5
Valid Total	100	100%

Table 5 represents that Chi2 test was performed between hydrophilic/hydrophobic yellow IOL and 1st week VA. All expected cell frequencies were greater than 5, thus the assumptions for the Chi2 test were met. There was no statistically significant relationship between hydrophilic/ hydrophobic yellow IOL and 1st week VA, $\chi^2(3) = 1.24$, $p = .744$, Cramér's $V = 0.11$. The calculated p-value of .744 is above than the defined significance level of 5%.

Table 6 represents that Chi2 test was performed between hydrophilic/ hydrophobic yellow IOL and 3rd week VA. All expected cell frequencies were greater than 5, thus the assumptions for the Chi2 test were met. There was a statistically significant relationship between hydrophilic/ hydrophobic yellow IOL and 3rd week VA, $\chi^2(2) = 6.03$, $p = .049$, Cramér's $V = 0.25$. The calculated p-value of .049 is lower than the defined significance level of 5%.

Table 7 shows that Chi2 test was performed between hydrophilic/ hydrophobic yellow IOL and 6th week VA. All expected cell frequencies were greater than 5, thus the assumptions for the Chi2 test were met. There was no statistically significant relationship between hydrophilic/ hydrophobic yellow IOL and 6th week VA, $\chi^2(2) = 2.66$, $p = .265$, Cramér's $V = 0.16$. The calculated p-value of .265 is above than the defined significance level of 5%.

Table 5: Post-operative distant vision – week 1

	1st week VA					Chi^2	df	p-value
	6/18	6/12	6/9	6/6	Total			
Hydrophilic IOL	5	12	23	10	50			
Hydrophobic Yellow IOL	5	14	25	6	50	1.24	3	0.744
Total	10	26	48	16	100			

Table 6: Post-operative distant vision- week 3

	3rd week VA				Chi^2	df	p-value
	6/12	6/9	6/6	Total			
Hydrophilic IOL	9	18	23	50			
Hydrophobic Yellow IOL	9	29	12	50	6.03	2	0.049
Total	18	47	35	100			

Table 7: Post operative distant vision-week 6

	6th week VA				Chi²	df	p-value
	6/12	6/9	6/6	Total			
Hydrophilic IOL	8	20	22	50			
Hydrophobic Yellow IOL	3	24	23	50	2.66	2	0.265
Total	11	44	45	100			

Table 8: Post-operative near vision-(Week 1, 3, 6)

Time Point	Group	N10	N12	N18	N24	Total	Chi square	df	p-value
Week 1	Hydrophilic IOL	10	19	19	2	50	5.71	0.127	0.127
	Hydrophobic Yellow IOL	12	27	11	0	50			
Week 3	Hydrophilic IOL	15	18	17	-	50	4.37	2	0.112
	Hydrophobic Yellow IOL	18	24	8	-	50			
Week 6	Hydrophilic IOL	17	24	9	-	50	14.14	2	0.001*
	Hydrophobic Yellow IOL	34	15	1	-	50			

The comparison of post-operative near vision (NV) outcomes between hydrophilic IOL and hydrophobic yellow IOL across three follow-up time points (Week 1, Week 3, and Week 6) revealed the following findings (**Table 8**).

At week 1, although a Chi-square test was performed to assess the relationship between IOL type and NV outcomes, the assumptions for the test were not fully met due to at least one expected cell frequency being less than 5. The test yielded a χ^2 value of 5.71 with a p-value of 0.127, indicating no statistically significant association between the type of IOL and NV at this time point.

At week 3, all expected frequencies were adequate for the Chi-square test. The results showed $\chi^2 = 4.37$ with 2 degrees of freedom and a p-value of 0.112. This result also indicated no statistically significant difference in NV outcomes between the two IOL groups at the third week post-operation.

At week 6, the chi-square assumptions were met, and a statistically significant difference was observed. The test yielded a χ^2 value of 14.14 with 2 degrees of freedom and a p-value of 0.001, which is below the 0.05 significance level. This indicates a significant association between the type of IOL implanted and near vision outcomes at the sixth postoperative week, with a notably higher proportion of patients with N10 vision in the hydrophobic yellow IOL group. These results suggest that while no significant differences in near vision outcomes were observed in the early postoperative weeks, by week 6, patients with hydrophobic yellow IOLs showed significantly better near vision compared to those with hydrophilic IOLs.

4. Discussion

The development of intraocular lenses (IOLs) has seen considerable progress in recent years. Due to the considerable advancements achieved, a wide range of IOL types are currently available in the market and some are also under development. So naturally, questions arose over which would be the best model IOL to endure. Specifically, there are some conversations regarding the superiority of hydrophilic versus hydrophobic intraocular lenses (IOLs).[16]

The current study also conducted with 2 groups of cataract patients. Group 1 included the patients with hydrophilic acrylic IOLs, and Group 2 included the patients with hydrophobic yellow IOLs. The parameters analyzed included preoperative visual acuity as well as postoperative visual acuity for both distance and near vision which are assessed at one week, three weeks, and six weeks after cataract surgery. This study concentrated on the most intriguing element of near vision following cataract surgery after the implantation of monofocal intraocular lenses.

The visual acuity was similar in both groups at each of the previously mentioned time intervals for distant vision. There was no difference between the hydrophilic and hydrophobic Yellow IOL groups with respect to the dependent variable distant vision at 6th week post operatively. Logistic regression analysis shows that the model as a whole is not significant (Chi square= 2.74, p .254, n = 100). This was comparable to the studies conducted by different authors like Riaz et al., Thom H et al., where it was noted that there was no significant difference between the two IOLs i.e hydrophilic and hydrophobic yellow IOL groups

regarding visual acuity for distance even after one year of follow up.[17,18]

Existing literatures indicated that a significant level of variability in optimal near vision following the implantation of monofocal intraocular lenses (IOLs).[19-23] This heterogeneity could be described by the differing definitions of "good" near vision. We considered a near vision of N 12 or better as "good" near vision in Snellen near vision chart. In this study, about ninety percentage of patients (90%, n = 91) had good near vision after 6 weeks after cataract surgery and IOL implantation (90%) i.e N12 and above. When the threshold for "good" near vision was adjusted to N10 units or lower, only approximately half of the participants (51%, n = 51) demonstrated "good" near vision.

There is a difference between the hydrophilic and hydrophobic yellow IOL groups with respect to the dependent variable of postoperative near vision at 6th week. Logistic regression analysis was performed to examine the influence of hydrophilic/ hydrophobic yellow IOL on variable 6th week NV to predict the value "N10". Logistic regression analysis shows that the model as a whole is significant (Chi square= 11.8, p .001, n = 100 indicating that this influence is statistically significant.

Thus, this study showed that the near vision post operatively is better with hydrophobic yellow IOL than hydrophilic IOL as found in study by Shentu X et al.[24] The standard monofocal IOLs (Hydrophilic IOL) possessed a predetermined refractive power and focal length, which means that the majority of patients need supplementary assistance to achieve clear vision at close distances. Several studies show that aberrations are associated with good near vision after monofocal IOL implantation.. The yellow-tinted hydrophobic IOLs and blue light-filtering IOLs are designed to replicate the electromagnetic transmission characteristics of the natural lens. This design aims to offer photoprotection and may enhance contrast sensitivity. Furthermore, the presence of blue light-filtering lenses may affect night vision, and these lenses offer a reduced degree of photoprotection in comparison to that afforded by mid-aged crystalline lenses. The hydrophobic yellow IOL being a photochromic IOL provides a dual advantage of blocking blue light at bright illumination, as well as allowing blue light in dim illumination which is required for resetting the biological clock and night vision. Significantly, the photochromic property is activated solely in the presence of ultraviolet light, specifically under bright illumination, resulting in a yellow coloration that effectively blocks blue and violet light. Thus, it may show improved near vision status after cataract surgery.[25-30]

Research concerning near vision correction utilizing monofocal IOLs remains pertinent even in the era of multifocal IOLs. Multifocal IOLs have consistently demonstrated their efficacy in addressing surgical presbyopia. However, they are accompanied by certain limitations related to cost, surgical technique, and patient-reported symptoms, such as glare, halos, and diminished contrast sensitivity. A survey showed that a significant majority of ophthalmologists (61.3%) favoured monofocal intraocular lens (IOL) implantation over multifocal options for their own use, attributing this preference to the enhanced quality of vision that monofocal lenses provide.[31] Furthermore, preexisting conditions such as severe corneal astigmatism and retinal disorders render the implantation of multifocal intraocular lenses inappropriate.[32] Hence, monofocal IOLs will remain prevalent until multifocal IOLs are deemed both flawless and economically accessible for the general population; therefore, ongoing research in this field is essential.

5. Limitations

Due to the retrospective nature of the data, we had limited control over the variables which could be included for analysis. We did not have information on other parameters affecting near vision postoperatively like pupil size, refractive status of eye, contrast sensitivity and patient satisfaction post-surgery. These would have been useful information in the comparison between these monofocal IOLs. Additionally, the data were collected from a smaller population; thus, the results may not be applicable to entire population.

6. Conclusion

Numerous factors are linked to optimal pseudophakic near vision like astigmatism and the induction of myopic refractive error, which are likely the sole modifiable factors that can be targeted during cataract surgery, to accommodate the near vision requirements of the patient. A randomized clinical trial may address this inquiry by evaluating the performance of the hydrophobic yellow IOL in achieving optimal near vision following cataract surgery.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Ethical Approval

Ethical No.: VMKVMC&H/IEC/24/272.

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Cite this article: Rajagopal R, Marimuthu B, Natarajan SGS, Ashokan S. A hospital based retrospective comparative study of near vision following cataract surgery by phacoemulsification using hydrophilic monofocal intraocular lens and hydrophobic monofocal yellow intraocular lens. *Indian J Clin Exp Ophthalmol*. 2025;11(3):487–492.