Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

# A study to compare the prevalence of posterior capsular opacity between patients implanted with hydrophobic acrylic intra ocular lens (IOL) versus hydrophilic acrylic intra ocular lens (IOL) in the diabetic and non-diabetic group following cataract surgery: A hospital based prospective study

**B Saravana Bhava[1], K Ezhil Vendhan[1], Thirumalai Sreneella[1]*, S Sindhuja Devi[1], B Jeyaprakash[1]**

[1]*Dept. of Ophthalmology, Vinayaka Missions Kirupananda Variyar Medical College and Hospitals, Salem, Tamil Nadu, India*

ARTICLE INFO

*Article history:*
Received 23-12-2023
Accepted 09-04-2024
Available online 30-09-2024

*Keywords:*
IOL-Intraocular lens
PCO-Posterior capsular opacification
LEC-Lens epithelial cells
VA-Visual acuity

ABSTRACT

**Aim and Objective**: To study and compare the prevalence of posterior capsular opacity between patients implanted with hydrophobic acrylic IOL versus hydrophilic acrylic IOL in the diabetic and non diabetic group following cataract surgery.

**Materials and Methods:** All patients with senile cataracts, whether they had diabetes or not, who visited a tertiary care hospital in Tamil Nadu between 2020 and 2022 were enrolled in this study after signing a written consent form. In this study, 200 patients underwent screening and were split into 4 equal groups.

**Results:** The PCO observation of patients in all 4 groups in the current study showed that Groups 3 and 4 with hydrophilic IOL found higher incidences of PCO than Groups 1 and 2 with hydrophobic IOL. In our study, more PCO was reported with hydrophilic IOL with known (Group 3) and unknown (Group 4) cases of diabetes.

**Conclusion:** Regardless of the patient's level of diabetes during the course of a year-long follow-up, hydrophobic acrylic IOLs showed a greater decrease in PCO rates than hydrophilic acrylic IOLs.

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

## 1. Introduction

The occurrence of posterior capsule opacification (PCO) has recently decreased because to advancements in intraocular lens (IOL) design and surgical competence. PCO is still a problem for everyone who does contemporary cataract surgery, though. Many contemporary IOLs contain this characteristic since it is generally known that square-edged IOL optics lower PCO rates.[1,2] Cunanan and coauthors[3] examined IOL materials using this method in a hydrated environment that more closely resembles the in vivo environment of an IOL. In comparison to hydrophilic IOLs, hydrophobic IOLs have a smaller air-bubble contact angle in water.

Although both hydrophobic and hydrophilic acrylic IOLs have a lengthy history of clinical success, there appear to be fundamental differences in the materials biocompatibility in the eye that could have therapeutic ramifications. Biocompatibility can be divided into uveal and capsular components.[4] The growth of anterior lens epithelial cells (LECs) on the IOL surface, anterior capsule opacification (ACO), and PCO are all signs of capsular biocompatibility. In general, hydrophilic IOLs exhibit less macrophage adherence than hydrophobic IOLs do, hydrophobic IOLs cause more ACO, and both materials cause LEC to develop from the capsulorhexis edge.[5]

* *Corresponding author*.
*E-mail address*: tsreneella@gmail.com (T. Sreneella).

https://doi.org/10.18231/j.ijceo.2024.077
2395-1443/© 2024 Author(s), Published by Innovative Publication.

Many surgeons believe that patients with diabetes have more widespread PCO after cataract surgery than patients without diabetes, based on their clinical observations. Several studies have quantitatively evaluated PCO, although the results are still controversial.[6]

Hence present study was carried out to compare the prevalence of Posterior capsular opacity between patients implanted with a hydrophobic acrylic intraocular lens (IOL) versus Hydrophilic acrylic intraocular lens (IOL) in the diabetic and non-diabetic groups following cataract surgery.

## 2. Materials and Methods

This was the Tertiary level hospital-based prospective study in which all the senile cataract patients with or without diabetes attending Vinayaga Mission's Kirupananda Variyar Medical College & Hospital were enrolled in this study after obtaining written informed consent. Two hundred patients were screened in this study, subdivided into 4 groups, 50 members in each group as follows:

**Group 1**: 50 patients with diabetes planned for hydrophobic intraocular lens implantation.

**Group 2**: 50 patients without diabetes planned for hydrophobic intraocular lens implantation.

**Group 3**: 50 patients with diabetes planned for hydrophilic intraocular lens implantation.

**Group 4**: 50 patients without diabetes planned for hydrophilic intraocular lens implantation.

The patient's required diabetic history and pertinent ocular history were noted, and they were thoroughly examined for visual acuity using a Snellen chart, a slit lamp examination for the anterior segment, a dilated fundus examination by slit lamp with a 90D lens, a direct and indirect ophthalmoscope examination, a fundus photograph taken with OCT, and a fundus camera for the necessary patients. The EDTRS system was used to assign a grade to diabetic retinopathy. Macular edema's existence or absence was also recorded.

Tonometry, sac syringing, keratometry, and an A-scan were all thoroughly evaluated prior to surgery. Patients who underwent cataract surgery and IOL implantation were monitored postoperatively at 1 month, 3 months, 6 months, and 1 year by performing an anterior segment slit lamp examination and measuring visual acuity. When evaluating PCO with slit lamp biomicroscopy under retro illumination, the PCO would have been graded using a standardized grading system.

A computerized literature search turned up information about contrasting hydrophobic acrylic intraocular lenses with hydrophilic acrylic intraocular lenses.

Enzymatic estimation was used to calculate blood tests like FBS, PPBS, and HbA1C. The early PCO prevalence in diabetic and non-diabetic individuals after the implantation of hydrophobic acrylic intraocular lenses versus hydrophilic acrylic intraocular lenses was investigated for 100 patients using the aforementioned methods.

Following cataract surgery, check in with the patients at 1 month, 3 months, 6 months, and 1 year to assess PCO changes using a slit lamp.

### 2.1. Inclusion criteria

The inclusion criteria for this study encompass individuals aged 40 and above exhibiting cataract changes, irrespective of gender. Additionally, eligible participants include senile cataract patients without systemic diseases and those with Type 2 Diabetes Mellitus presenting with senile cataract.

### 2.2. Exclusion criteria

The exclusion criteria for this study include patients with an age less than 40, a history of other ocular surgery, a history of taking steroids for other systemic disorders, cataract surgery with anterior lens intraocular lens (IOL), post-operative endophthalmitis, intra-operative complications, and patients with other chronic ocular diseases or uveitis.

## 3. Results

The average age of the patients in the four groups in the current investigation was found to be nearly same (Group 1: 58.44; Group 2: 58.38; Group 3: 58.66; Group 4: 58.5).(Figure 1)

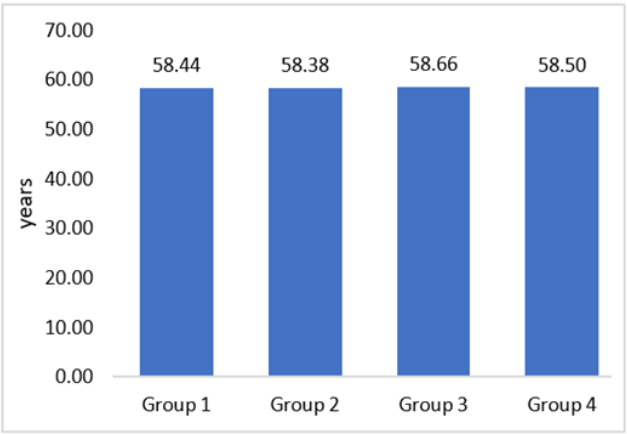


**Figure 1:** Mean age of patients in all groups

In each group, the gender distribution of the patients was also noted, and it was discovered that the male proportion was higher than the female proportion (Figure 2).

In our investigation, the VA preoperative status of every patient in every group was documented.VA 3/60, 4/60, 5/60 and 6/60 was reported maximum in Group 4, 5(38.5%), Group 1, 13 (30.2%), Group 2, 11 (37.9%) and Group 2, 3 each with 23 (27.4%) respectively. Whereas VA preoperative CF, PL and PR were reported maximum in Group 1, 4 (36.4%), Group 2, 4 (40%) and Group 1, 3 each with 4 (40%) respectively (Figure 3)

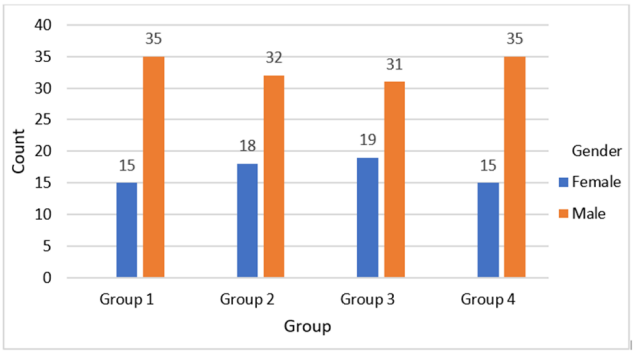


**Figure 2:** Gender distribution among all groups

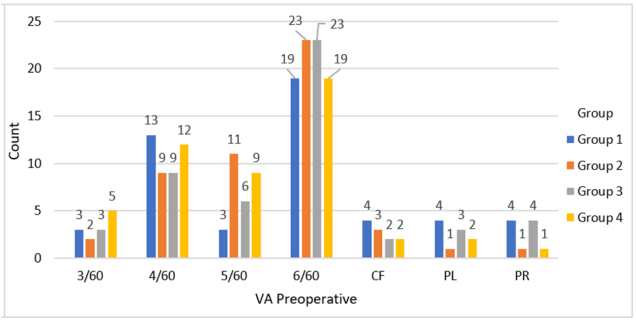


**Figure 3:** Observation of pre-operative visual acuity (VA) parameter in patients of all group

All patients in all groups had their postoperative visual acuity for the first month (VA-1 month) measured. In Groups 1 and 3 respectively, the maximum VA-1 month 6/6, 6/9, and 6/18 reports were 40 (26.8%), Group 4, 11 (36.7%), and Group 2, 8 (38.1%) (Table 1)

Visual acuity postoperative 3 months (VA-3 months) was recorded in all patients of all groups. VA-3 months 6/24, 6/18, 6/9 and 6/6 was reported maximum in Group 1, 4 (66.7%), Groups 3 and 4, 4(36.4%), Group 2, 3 (75%) and Group 3 and 4 each with 46 (25.7%) respectively (Table 2).

Visual acuity postoperative 6 months (VA-6 months) was recorded in all patients of all groups. VA-6 month 6/24, 6/18, 6/9 and 6/6 was reported maximum in Groups 1, 7 (14.6%) Groups 4, 5(11.6%), Group 3, 40(87%) and Groups 1, 7 (14.6%) respectively (Table 3)

Visual acuity postoperative 6 months (VA-1 year) was observed in patients of all groups. VA-1 year 6/24, 6/18, 6/9 and 6/6 were reported maximum in Groups 1, 7 (14.6%), Groups 4, 5(11.6%), Groups 1, 7 (14.6%) and Group 3, 40(87%) respectively. There was no change in VA reading after 6 months at all parameters (Table 4)

In the current study, PCO grades observation was carried out after 1 month post-operative in patients of all groups. However, PCO grade 1 was observed only in Group 4 patients 1 (100%) (Figure 4)

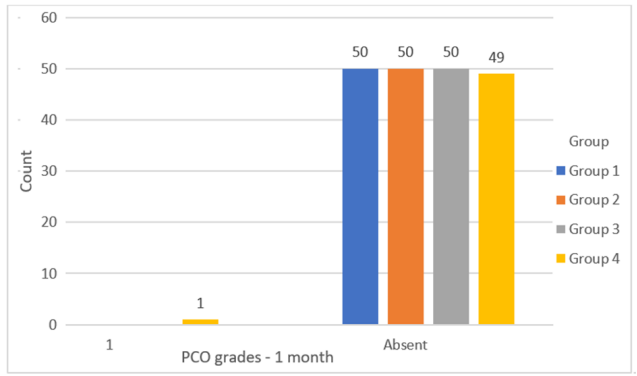


**Figure 4:** Observation of PCO grades after 1 month of surgery in patients of all groups

In our study, PCO-grade observation was carried out after 3 months post-operative in patients of all groups. PCO grade 1 was observed maximum in Group 4 patients 4 (50%)(Figure 5)

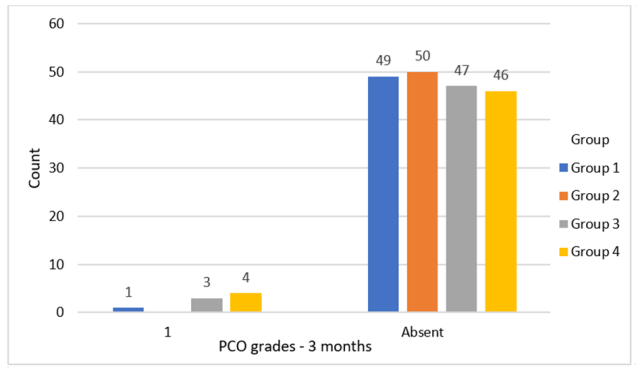


**Figure 5:** Observation of PCO grades after 3 month of surgery in patients of all groups

In our study, PCO grade observation was carried out after 6 months post-operative in patients of all groups. PCO grade 1 was observed maximum in Group 3 patients 5 (10.9%), and Grade II was found to be highest in Group 4, 1 (2.3%) (Figure 6)

PCO grades observation was also carried out after 1 year post-operative in patients of all groups. PCO grade 1 was observed maximum in Group 3 patients 4 (8.7%), Grade II was found highest in Group 4, 5 (11.6%) and Grade III was reported mostly in Group 4, 2 (4.7%)(Figure 7)

The PCO observation was carried out for individual groups of patients. It was found that PCO was reported maximum of 11 (23.9%) in group III patients and a minimum of 1 (2.1%) in Group 2 patients(Figure 8).

## 4. Discussion

Cataract procedures have frequently employed both hydrophilic and hydrophobic materials. In the present study

**Table 1:** Observation of VA post-operative after 1 month in patients of all groups

| | | | Group | | | | Total | P value |
|---|---|---|---|---|---|---|---|---|
| | | | Group 1 | Group 2 | Group 3 | Group 4 | | |
| VA - 1 month | 6/6 | Count | 40 | 34 | 40 | 35 | 149 | 0.249 |
| | | % within VA - 1 month | 26.8% | 22.8% | 26.8% | 23.5% | 100.0% | |
| | 6/9 | Count | 5 | 8 | 6 | 11 | 30 | |
| | | % within VA - 1 month | 16.7% | 26.7% | 20.0% | 36.7% | 100.0% | |
| | 6/18 | Count | 5 | 8 | 4 | 4 | 21 | |
| | | % within VA - 1 month | 23.8% | 38.1% | 19.0% | 19.0% | 100.0% | |
| Total | | Count | 50 | 50 | 50 | 50 | 200 | |
| | | % within VA - 1 month | 25.0% | 25.0% | 25.0% | 25.0% | 100.0% | |

**Table 2:** Observation of VA post operative after 3 months in patients of all groups

| | | | Group | | | | Total | P value |
|---|---|---|---|---|---|---|---|---|
| | | | Group 1 | Group 2 | Group 3 | Group 4 | | |
| VA - 3 months | 6/6 | Count | 45 | 42 | 46 | 46 | 179 | 0.042 |
| | | % within VA - 3 months | 25.1% | 23.5% | 25.7% | 25.7% | 100.0% | |
| | 6/9 | Count | 1 | 3 | 0 | 0 | 4 | |
| | | % within VA - 3 months | 25.0% | 75.0% | 0.0% | 0.0% | 100.0% | |
| | 6/18 | Count | 0 | 3 | 4 | 4 | 11 | |
| | | % within VA - 3 months | 0.0% | 27.3% | 36.4% | 36.4% | 100.0% | |
| | 6/24 | Count | 4 | 2 | 0 | 0 | 6 | |
| | | % within VA - 3 months | 66.7% | 33.3% | 0.0% | 0.0% | 100.0% | |
| Total | | Count | 50 | 50 | 50 | 50 | 200 | |
| | | % within VA - 3 months | 25.0% | 25.0% | 25.0% | 25.0% | 100.0% | |

**Table 3:** Observation of VA post operative after 6 months in patients of all groups

| | | | Group | | | | Total | P value |
|---|---|---|---|---|---|---|---|---|
| | | | Group 1 | Group 2 | Group 3 | Group 4 | | |
| VA - 6 months | 6/6 | Count | 32 | 39 | 40 | 31 | 142 | 0.032 |
| | | % within Group | 66.7% | 83.0% | 87.0% | 72.1% | 77.2% | |
| | 6/9 | Count | 7 | 3 | 1 | 6 | 17 | |
| | | % within Group | 14.6% | 6.4% | 2.2% | 14.0% | 9.2% | |
| | 6/18 | Count | 2 | 0 | 3 | 5 | 10 | |
| | | % within Group | 4.2% | 0.0% | 6.5% | 11.6% | 5.4% | |
| | 6/24 | Count | 7 | 5 | 2 | 1 | 15 | |
| | | % within Group | 14.6% | 10.6% | 4.3% | 2.3% | 8.2% | |
| Total | | Count | 48 | 47 | 46 | 43 | 184 | |
| | | % within Group | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

**Table 4:** Observation of VA post operative after 1 year in patients of all groups

| | | | Group | | | | Total | P value |
|---|---|---|---|---|---|---|---|---|
| | | | Group 1 | Group 2 | Group 3 | Group 4 | | |
| VA - 1 year | 6/6 | Count | 32 | 39 | 40 | 31 | 17 | 0.032 |
| | | % within Group | 66.7% | 83.0% | 87.0% | 72.1% | 9.2% | |
| | 6/9 | Count | 7 | 3 | 1 | 6 | 142 | |
| | | % within Group | 14.6% | 6.4% | 2.2% | 14.0% | 77.2% | |
| | 6/18 | Count | 2 | 0 | 3 | 5 | 15 | |
| | | % within Group | 4.2% | 0.0% | 6.5% | 11.6% | 8.2% | |
| | 6/24 | Count | 7 | 5 | 2 | 1 | 10 | |
| | | % within Group | 14.6% | 10.6% | 4.3% | 2.3% | 5.4% | |
| Total | | Count | 48 | 47 | 46 | 43 | 184 | |
| | | % within Group | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

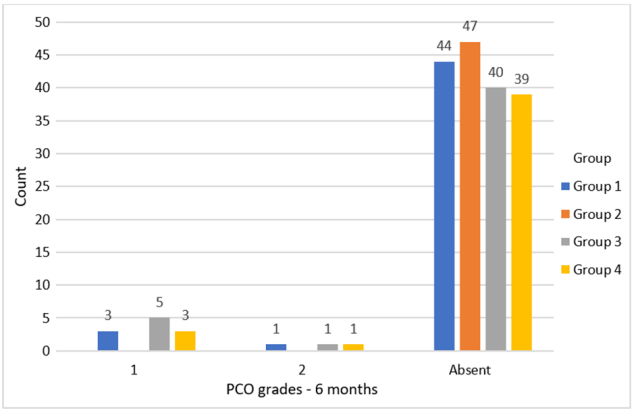


**Figure 6:** Observation of PCO grades after 6 month of surgery in patients of all groups

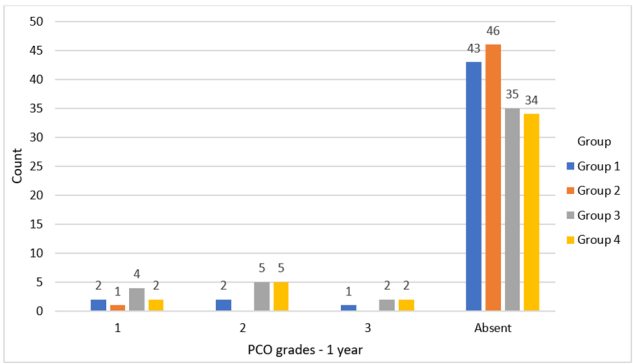


**Figure 7:** Observation of PCO grades after 1 year of surgery in patients of all groups

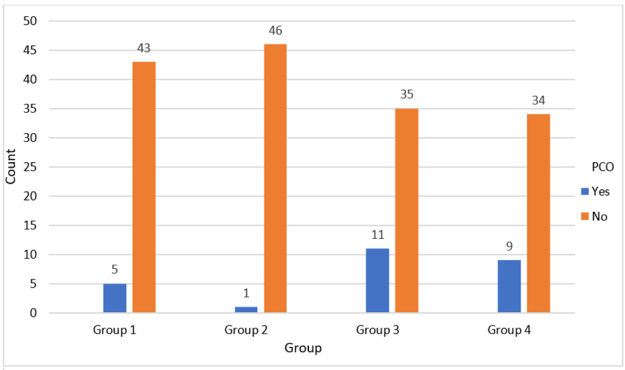


**Figure 8:** Observation of PCO for individual group patients

mean age of patients in all four groups was found to be almost the same (Group 1: 58.44; Group 2: 58.38; Group 3: 58.66 and Group 4: 58.5). Praveen et al.,[7] in their study reported mean age of 59 years of diabetic group and 61 years for non-diabetic group patients Which close to our study observations. In comparison, Ebihara et al[8] reported 66.2 years as the mean age of patients in their study.

Gender distribution of patients was also recorded in all groups, and it was found that male patients were higher than females. Sahu et al.[9] also reported male predominance, the same as our study finding. However, Ebihara et al.[10] reported a higher proportion of female patients in their study.

Our study studied VA preoperative in all patients of all groups. VA 3/60, 4/60, 5/60 and 6/60 was reported maximum in Group 4, 5(38.5%), Group 1, 13 (30.2%), Group 2, 11 (37.9%) and Group 2, 3 each with 23 (27.4%) respectively. On the other hand, Group 1, 4 (36.4%), Group 2, 4 (40%), and Group 1, 3 each with 4 (40%) had the highest levels of VA preoperative CF, PL, and PR. These findings in the present study follow earlier reported studies.[11]

All patients' post-operative visual acuity was studied after 1, 3, 6 months and 1 year. When VA statistics from different groups were examined over time, they all showed a steady rise in VA. It is commonly known that both subjective and objective visual function is usually enhanced following cataract surgery. Over the course of a year, Group 2 participants showed the greatest improvement in VA. After undergoing cataract surgery, the majority of patients with healthy eyes report noticeably better, more colorful, and brighter vision. Similar findings from Hayashi

et al investigations were also reported where both diabetic and non-diabetic individuals showed an improvement in VA. No of whether a patient has diabetes or not, several other researches show that cataract surgery improves their vision.[12]

In the current study, PCO grades observation was carried out after 1 month post-operative in patients of all groups. PCO grade 1 was observed only in Group 4 patients (hydrophobic IOL). PCO grade 1 was observed in Group 1 (12.5%), 3 (37.5% and 4 (50%). The PCO in Groups 3 and 4 with hydrophobic IOL was much higher than in Group 1 with hydrophilic IOL. PCO grades observation after 6 months post-operative in patients of all groups revealed that PCO grade 1 was observed maximum in Group 3 patients (10.9%), and Grade II was found to be highest in Group 4(2.3%). PCO grades observation was also carried out after 1 year post-operative in patients of all groups. PCO grade 1 was observed maximum in Group 3 patients (8.7%), Grade II was found to be highest in Group 4 (11.6%) and Grade III was reported maximum in Group 4 (4.7%). The PCO observation of patients in all 4 groups in the current study showed that Groups 3 and 4 with hydrophilic IOL found higher incidences of PCO than Groups 1 and 2 with hydrophobic IOL.

The PCO observation was carried out for individual groups of patients. It was found that PCO was reported at a maximum of 11 (23.9%) in group III patients and a minimum of 1 (2.1%) in Group 2 patients. In our study, more PCO was reported with hydrophilic IOL with known (Group 3) and unknown (Group 4) cases of diabetes. The result of the present study supports the theory that compared to hydrophilic acrylic IOLs, hydrophobic acrylic IOLs led to significantly less. Heatley et al.,[13] in their investigation, reported 50.3% PCO with hydrophilic IOL and only 4.9 % PCO with hydrophobic IOL, which is comparable to the findings of our study. Li et al. also found hydrophobic IOL better than hydrophilic IOL in reducing PCO in their study.[14]

A new factor to think about when choosing lens material is the hybrid method (IOLs with a hydrophilic centre and a hydrophobic surface coating), which shows that hybrid IOLs are less prone to cell adhesion than hydrophilic IOLs and less prone to glistening development than hydrophobic IOLs. The performance of PCO with the copolymer hybrid IOLs should be further assessed in clinical research as they may offer significant advantages.[15]

## 5. Conclusion

In summary, Group 4 displayed the highest total percentage of PCO development, with 100% experiencing grade 1 within the first month, underscoring the importance of vigilant monitoring in cataract surgery patients with specific intraocular lens materials. Throughout a 1-year follow-up, hydrophobic acrylic IOLs demonstrated a higher decrease in PCO rates than hydrophilic acrylic IOLs, regardless of the patient's diabetes state. To confirm the association, additional research employing standardized procedures, a larger study group, and a longer follow-up time are needed.

## 6. Ethical Approval

This syudy was conducted after taking approval from the institute ethical committee (VMKVMC&H/IEC/21/066).

## 7. Source of Funding

Nil.

## 8. Conflicts of Interest

The author reports no conflicts of interest in this work

## References

1. Nishi O, Nishi K, Wickström K. Preventing lens epithelial cell migration using intraocular lenses with sharp rectangular edges. . *J Cataract Refract Surg*. 2000;26(10):1543–9.
2. Peng Q, Visessook N, Apple DJ, Pandey SK, Werner L, Escobar-Gomez M, et al. Surgical prevention of posterior capsule opacification. Part 3: intraocular lens optic barrier effect as a second line of defence. *J Cataract Refract Surg*. 2000;26(2):198–213.
3. Cunanan CM, Ghazizadeh M, Buchen SY, Knight PM. Contact-angle analysis of intraocular lenses. *J Cataract Refract Surg*. 1998;24(3):341–51.
4. Abela-Formanek C, Amon M, Schild G, Schauersberger J, Heinze G, Kruger A. Uveal and capsular biocompatibility of hydrophilic acrylic, hydrophobic acrylic, and silicone intraocular lenses. *J Cataract Refract Surg*. 2002;28(1):50–61.
5. Hollick EJ, Spalton DJ, Ursell PG. Surface cytologic features on intraocular lenses; can increase biocompatibility have disadvantages. *Arch Ophthalmol*. 1999;117(7):872–8.
6. Buehl W, Findl O. Effect of intraocular lens design on posterior capsule opacification. *J Cataract Refract Surg*. 2008;34(11):1976–85.
7. Praveen M, Vasavada AR, Shah GD, Shah AR, Khamar B, Dave KH. A prospective evaluation of posterior capsule opacification in eyes with diabetes mellitus: a case–control study. *Eye (Lond)*. 2014;28(6):720–7.
8. Ebihara Y, Kato S, Oshika T, Yoshizaki M, Sugita G. Posterior capsule opacification after cataract surgery in patients with diabetes mellitus. *J Cataract Refract Surg*. 2006;32(7):1184–7.
9. Sahu P, Mishra AK. Determinants of posterior capsular opacity after cataract surgery: a cross-sectional study. *Int J Res Med Sci*. 2019;7(2):1–5.
10. Kugelberg M, Wejde G, Jayaram H, Zetterström C. Posterior capsule opacification after a hydrophilic or a hydrophobic acrylic intraocular lens implantation: one-year follow-up. *J Cataract Refract Surg*. 2006;32(10):1627–31.
11. Hayashi K, Hayashi H, Nakao F, Hayashi F. Posterior capsule opacification after cataract surgery in patients with diabetes mellitus. *Am J Ophthalmol*. 2002;134(1):10–6.
12. Heatley CJ, Spalton DJ, Kumar A, Jose R, Boyce J, Bender LE. Comparison of posterior capsule opacification rates between hydrophilic and hydrophobic single-piece acrylic intraocular lenses. *J Cataract Refract Surg*. 2005;31(4):718–24.
13. Li Y, Wang J, Chen Z, Tang X. Effect of hydrophobic acrylic versus hydrophilic acrylic intraocular lens on posterior capsule opacification: meta-analysis. *PLoS One*. 2013;8(11):77864.
14. Nagata T, Minakata A, Watanabe I. Adhesiveness of AcrySof to a collagen film. *J Cataract Refract Surg*. 1998;24(3):367–70.

15. Fujita S, Tanaka T, Miyata A, Hirose M, Usui M. Cell adhesion and glistening formation in hybrid copolymer intraocular lenses. *Ophthalmic Res*. 2012;48(2):102–8.

## Author biography

**B Saravana Bhava,** Professor https://orcid.org/0000-0002-9295-1350

**K Ezhil Vendhan,** Professor https://orcid.org/0000-0002-8410-6755

**Thirumalai Sreneella,** Junior Resident https://orcid.org/0009-0001-8417-7836

**S Sindhuja Devi,** Senior Resident https://orcid.org/0009-0000-8123-2361

**B Jeyaprakash,** Associate Professor https://orcid.org/0000-0003-0546-0017

**Cite this article:** Bhava BS, Vendhan KE, Sreneella T, Devi SS, Jeyaprakash B. A study to compare the prevalence of posterior capsular opacity between patients implanted with hydrophobic acrylic intra ocular lens (IOL) versus hydrophilic acrylic intra ocular lens (IOL) in the diabetic and non-diabetic group following cataract surgery: A hospital based prospective study. *Indian J Clin Exp Ophthalmol* 2024;10(3):447-453.