Original Article

A comparison of posterior capsular opacification after implantation of three different hydrophobic square edge intraocular lenses

H Vijaya Pai, Atiya Pathan[1], Yogish Subraya Kamath

Purpose: To compare the posterior capsular opacification (PCO) after implantation of three types of hydrophobic square edge intraocular lenses (IOLs). **Methods:** A single-center, hospital-based, cross-sectional, observational study was conducted wherein patients with senile cataract who had undergone phacoemulsification by a single surgeon, with the implantation of three different types of square edge, hydrophobic IOLs [Group 1: enVista, Bausch and Lomb; Group 2: Tecnis 1 ZCBOO, AMO and Group 3: Acrysof IQ SN60WF, Alcon], and followed up for 12 months were included. The PCO was graded clinically and scored using the EPCO 2000 software. **Results:** 90 eyes of 90 patients were included. There was no significant difference in the PCO with respect to age, gender, or associated presence of systemic disease. The median PCO score was 0.035, 0.045 and 0.085 in groups 1, 2 and 3, respectively. The PCO grade and score differences between the groups were statistically significant with $P < 0.001$. **Conclusion:** The hydrophobic nature and posterior square edge design in the IOLs probably contributed to the minimal visually-significant PCO in all the groups, in our study. However, PCO scores were lesser in the square edge IOLs having a continuous 360 degrees posterior enhanced barrier, than those without this feature.

Key words: Intraocular, lenses, phacoemulsification, posterior capsule opacification, square- edge

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Posterior capsular opacification (PCO) is an expected sequel following any form of extracapsular cataract surgery. It is responsible for the decrease in visual acuity and quality of vision in the late postoperative period.[1] If severe, it may also lead to contraction of the capsular bag with resultant gradual decenteration of the intraocular lens (IOL) placed within. Numerous studies have tried to explain the occurrence of PCO. Some have implicated the surgical technique,[2,3] while most have targeted the IOL material and design.[4,5] The hydrophobic acrylic material and a square edge design of the posterior IOL surface have been identified as the most important factors in the IOL which prevent PCO.[6] Subtle variations in the amount of PCO formed persist despite the incorporation of these features in the commercially available IOLs. Although this may not be severe enough to obstruct the visual axis, peripheral capsular opacities may affect the overall quality of vision. In this study, we compare the PCO after implantation of hydrophobic IOLs with square posterior edge design, in a South Indian cohort.

Methods

This was a cross-sectional observational study performed in a tertiary care hospital in South India. The patients who had undergone phacoemulsification with foldable IOL implantation in one eye for age-related cataract by a single surgeon, at least 12 months earlier, were included. All the patients had undergone a temporal clear corneal phacoemulsification (using Infiniti Vision system, Alcon), through a 2.2-2.8 mm wound (as per the IOL specifications) by a single surgeon. A continuous curvilinear capsulorrhexis followed by cortical cleaving hydro dissection and nucleofractis by the stop and chop technique had been performed. Bimanual irrigation-aspiration of the cortex followed by posterior capsule polishing had been done in all the cases. A foldable hydrophobic square edged IOL had been implanted followed by a thorough aspiration of viscoelastic substance from the anterior chamber and capsular bag before wound closure. Patients in whom any of the above-mentioned steps of surgery had to be skipped or altered, were excluded. The guidelines of the Declaration of Helsinki were complied with and the Institutional Ethical Committee clearance obtained. A written informed consent was obtained from all participants.

On the basis of the type of IOL implanted, consecutive patients were divided into three groups: Group 1: enVista, Bausch and Lomb; Group 2: Tecnis 1 ZCBOO, AMO; and Group 3: Acrysof IQ SN60WF, Alcon. Once included in the study, all participants underwent visual acuity by the Snellen's visual acuity test for distance vision, and slit lamp biomicroscopic evaluation of anterior segment. The position of IOL and clinical grading of PCO was then done after dilating the pupil with Tropicamide 1% eye drops. This was

Department of Ophthalmology, Kasturba Medical College-Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, [1]Tejas Eye Hospital, Divya Jyoti Trust, Mandvi, Gujarat, India

Correspondence to: Dr. Yogish Subraya Kamath, Department of Ophthalmology, Kasturba Medical College-Manipal, Manipal Academy of Higher Education, Manipal - 576 104, Karnataka, India. E-mail: dryogishkamath@yahoo.co.in

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followed by a slit lamp anterior segment photograph (Haag Streit Eye Suite imaging system attached to a BQ900 slit lamp Biomicroscope) by the retro-illumination mode. The images thus obtained were used to score the PCO using the Evaluation of the posterior capsular opacification (EPCO) 2000 software. The scoring was performed by a trained ophthalmic technician.

The clinical grading of PCO was as per Kucuksumer Y *et al*.[7] (Grade 0-Posterior capsule completely clear and no LEC migration; Grade 1-LEC migration at the periphery with a clear visual axis; Grade 2-LEC migration onto the visual axis with no drop in best corrected visual acuity (BCVA); Grade 3-LEC migration onto the visual axis with BCVA better than 6/12; Grade 4-LEC migration onto the visual axis and BCVA of 6/12 worse). Grade 4 PCO was considered as visually significant PCO and was considered as an indication for Nd-YAG capsulotomy. To simplify the analysis, three groups were made from the above grading system. These include "PCO absent" (Grade 0); "Vision spared" (Grades 1 and 2) and "Vision affected" (Grades 3 and 4) groups. The grading of the posterior capsular opacification was done using a slit lamp biomicroscope by an ophthalmologist other than the operating surgeon.

The scoring of PCO using the EPCO software involved the multiplication of the grade of the density of opacity behind the optic, with the total area of posterior capsule under the opacity calculated by the pixel count.

A convenience sample of 30 consecutive patients in each of the three groups was taken. The PCO grade and score were analyzed using the Chi square test and, the Kruskal Wallis test for significance respectively. The data was analyzed using SPSS vr. 15.

Results

A total of 90 eyes of 90 patients were included in the study. The mean age of the patients was 66.53 years, 63.63 years and 66.1 years in Groups 1, 2 and 3 respectively. Among the cohort, 56.7% were females. Diabetes mellitus was present in 22.2% of the patients. The visual acuity was 6/9 or better in the patients of all the 3 groups, except for one patient in Group 3, who had an acuity of 6/18. The mean follow-up period was 14.03 months, 13.7 months and 14.8 months in Groups 1, 2 and 3 respectively [Table 1].

The capsulorrhexis margin- anterior optic surface overlap was not present over 360 degrees in 5 of 90 eyes. Of these five eyes, one had grade 3 PCO and the other four had Grade 2 PCO. Considering this as a confounding factor, these patients were excluded from further PCO grade and score analysis.

Posterior capsular opacification grades were as depicted in Table 2 and Fig. 1. The PCO affecting visual acuity was noted in 22.23% of patients of group 3 and 10.34% of patients in the other two groups. Statistical analysis of PCO grade was done using the Chi square test, where a significant difference was found between the groups (P value = 0.001). The PCO scores are depicted in Table 3 and Fig. 2. There was a significant difference in the PCO score seen in the different IOLs ($P < 0.001$) as per the Kruskal Wallis test, with Group 1 having the least PCO score.

Only one patient developed grade 4 PCO and underwent Nd- YAG laser posterior capsulotomy.

Discussion

Posterior capsular opacification is a common late sequel following IOL implantation.[1] The advances in the technique of phacoemulsification as well as IOL material and design have decreased its occurrence, which can be inferred from the lower rates of Nd YAG posterior capsulotomy in recent years.[7]

In our study, phacoemulsification with continuous curvilinear capsulorrhexis, hydrodissection, and meticulous cortical clean-up prior to IOL insertion were performed for all patients by a single surgeon. This surgical technique is known to be most efficacious in preventing PCO formation.[2,3] All the IOLs in our study were variants of a hydrophobic acrylic material which is known to have lesser PCO rates compared to silicone or polymethylmethacrylate (PMMA) materials.[8]

The IOLs in our study also had a posterior square edge design which has been stated to be an important factor in preventing PCO.[9]

Thus, the overall PCO in our study with hydrophobic, posterior square edge IOLs was minimal. The PCO grade affecting visual acuity was only seen in 14.11% of the patients. The requirement of Nd YAG capsulotomy for visually signifi cant PCO was noted in only 1.12% eyes in our study as compared with other studies where the rates ranged from 2.0 to 8.9%.[10-13]

Table 1: Demographic details and Visual acuity

Gender Number [%]	Male Female		39 [43.3] 61 [56.7]	
	Group 1 (n=30)	Group 2 (n: 30)	Group 3 (n: 30)	Total (n: 90)
Age (Years [± Standard deviation])	66.53 [7.99]	63.63 [9.4]	66.13 [10.97]	65.43 [9.51]
Diabetes mellitus number of patients [%]	8 [26.67]	8 [26.67]	4 [13.33]	20 [22.23]
Postoperative follow-up [months]				
Mean	14.03	13.7	14.8	14.17
Minimum	12	12	12	12
Maximum	19	18	18	19
Visual Acuity (Snellens)				
6/6 or better	24	27	20	71
6/9	6	3	9	18
6/12 or worse	0	0	1	1

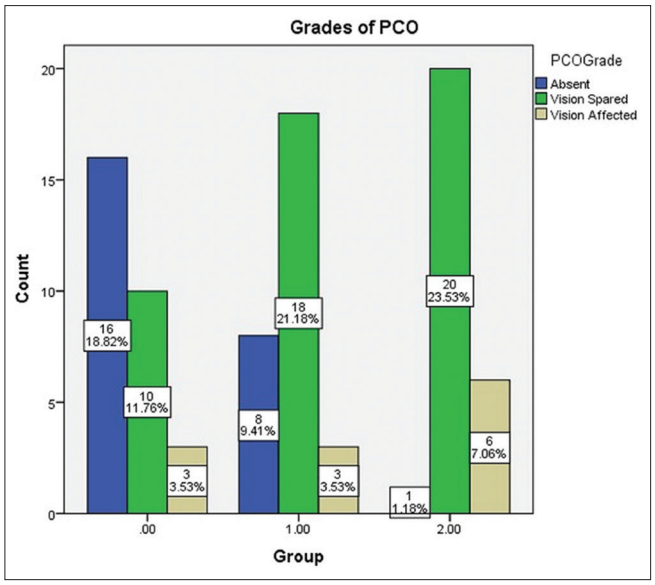

Figure 1: Posterior Capsular Opacification (PCO) Grade in different groups

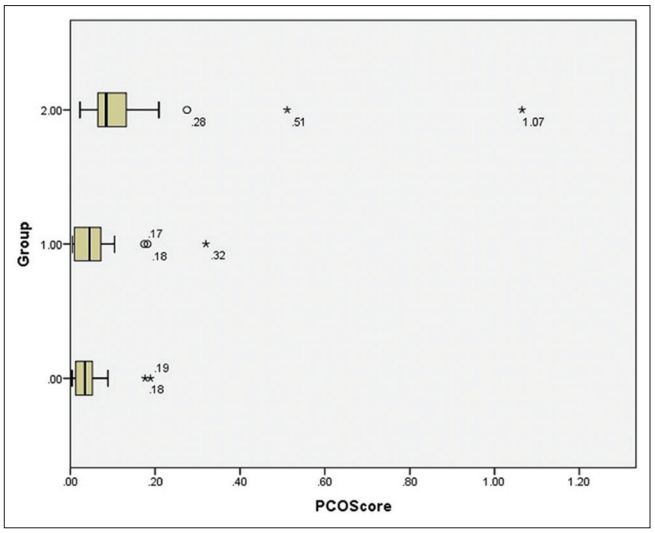

Figure 2: Posterior Capsular Opacification (PCO) Score in different groups

Table 2: PCO grade

PCO Grade	Group 1	Group 2	Group 3	Total
Absent [Grade 0]	16	8	1	25
Vision Spared [Grade 1 and 2]				
Vision Affected	10	18	20	48
[Grade 3 and 4]	3	3	6	12
Total	29	29	27	85

PCO=Posterior Capsule Opacification, [Chi square=18.610, *P*=0.001]

Table 3: PCO Score

Group	PCO Score			Kruskal Wallis, *P*
	Median	Percentile 25	Percentile 75	
Group 1	0.0350	0.0125	0.0530	*P*<0.001
Group 2	0.0450	0.0100	0.0730	
Group 3	0.0850	0.0640	0.1320	

PCO=Posterior Capsule Opacification

However, apart from these two major factors, we intended to study other minor features which play a role in preventing subtle PCO. This becomes important, considering the effects of capsular bag alteration and PCO on the final visual outcome after implantation of premium IOLs.

The anterior capsulorrhexis - optic overlap deficiency leading to the more advanced grades of PCO has been reported earlier.[14,15] In our study, all the 5 eyes with this deficiency had PCO grade of 2 or more.

The other important factor was the presence of a continuous 360-degree posterior enhanced square edge with good apposition of the optic to the posterior capsule. The presence of such a continuous barrier is known to prevent the lens epithelial cell migration from the optic-haptic junction, toward the visual axis.[16,17] The IOLs in Group 1 and 2 both offered this feature and also had anteriorly offset haptics for better contact with the posterior capsule. IOLs of Group 3 lacked this feature. The absence of a 360 degree continuous enhanced square edge posterior barrier may be the reason for increased PCO score in Group 3.[18]

Although this did not cause deterioration of visual acuity or migrate to the visual axis in our study, such subtle peripheral PCO may result in poor quality of vision over a longer period of time. PCO has been established as a major cause of deterioration of visual function following multifocal IOL implantation.[19,20]

The limitations of our study were the small sample size, single center setting and a cross sectional design at 12 months following surgery. A longitudinal follow up over a longer period might have been more informative.

Conclusion

To conclude, the benefit of a posterior square edge design and hydrophobic acrylic material in preventing PCO has been reinforced by the present study. The study also highlights the benefits of a 360-degree continuous enhanced posterior square edge in preventing PCO. The additional use of software-based retro illumination photograph analysis enables documentation of subtle peripheral PCO unlike some studies using the Nd YAG capsulotomy rates as indicative of PCO grades. The intraoperative factors including capsulorrhexis size and optic centration so as to achieve rhexis-optic overlap also play a role in preventing PCO formation.

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Conflicts of interest

There are no conflicts of interest.

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