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Clinical Profile of Posterior Capsular Opacification

Dr. Kunal Uday Patil[1*], Dr. Krishna Nalawade[2], Dr. Varsha Kunal Patil[3]

[1]Assistant Professor, Department of Ophthalmology, Prakash Institute of Medical Sciences, Urun, Islampur, Maharashtra, India.
[2]Professor & HOD, Department of Ophthalmology, Prakash Institute of Medical Sciences, Urun, Islampur, Maharashtra, India.
[3]Assistant Professor, Department of Anesthesiology, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India.

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ABSTRACT

Background
Posterior Capsular Opacification (PCO), commonly referred to as "after cataract," is the most frequent long-term complication following cataract surgery, particularly in cases where the posterior capsule is left intact. It results from residual lens epithelial cell proliferation and migration, leading to visual impairment.

Objectives
This study aimed to assess the clinical profile of PCO in a rural population and evaluate visual outcomes following Nd:YAG laser posterior capsulotomy.

Methods
A prospective observational study was conducted over two years (September 2019–August 2020) involving 70 eyes diagnosed with PCO at a rural tertiary care center. Patients previously treated for PCO in the same eye were excluded. Comprehensive ophthalmic evaluations were performed, including assessment of visual acuity, intraocular pressure, slit-lamp biomicroscopy, fundus examination, and evaluation of intraocular lens (IOL) type and design.

Results
The mean age of patients was 58.82 years, with a slight male predominance (54.28%). Most PCO cases presented 12–24 months post-cataract surgery. PMMA lenses were the most commonly associated with PCO (72.85%), especially those with round optic edges. Hydrophilic acrylic IOLs had a higher incidence of PCO compared to hydrophobic ones. Continuous curvilinear capsulorhexis (CCC) was the predominant capsulotomy type (65.71%). Fibrous PCO was the most frequently observed type (42.85%), followed by Elschnig's pearls and mixed forms. Nd:YAG laser capsulotomy significantly improved visual outcomes in the majority of cases.

Conclusion

The type and design of IOLs, particularly edge configuration and material, play a critical role in PCO development. Hydrophobic acrylic lenses with square edges significantly reduce PCO incidence. Nd:YAG laser capsulotomy remains an effective and safe outpatient treatment for visual rehabilitation in PCO cases.
Keywords: Posterior Capsular Opacification (PCO), Cataract Surgery Complications, Nd:YAG Laser Capsulotomy, Intraocular Lens (IOL), Visual Acuity, PMMA vs Acrylic IOL, Fibrous PCO, Elschnig Pearls, IOL Edge Design, Rural Ophthalmology.

INTRODUCTION

In extra capsular cataract extraction, anterior capsulotomy is done and intra ocular lens is put in the capsular bag with the posterior capsule intact. Posterior capsular opacification, referred to as 'secondary cataract' or 'after cataract', develops over the clear posterior capsule a few months to a few years after an uneventful cataract surgery. PCO results from the growth and abnormal proliferation of LECs on the capsule at the time of cataract surgery. These cells migrate to the posterior capsule where they approach the central visual axis and cause visual axis obscuration, resulting in dimness of vision.

So, after surgery, one of the most treatable complication is posterior capsular opacification (PCO) requiring treatment in upto 50% of patients after 3 years of surgery.[1]

Posterior capsular opacification is influenced by following factors:

1. Age of patient
2. Skill of surgeon and surgical technique
3. Type of intraocular lens used
4. Previous operation followed by iritis

The PCO has two forms, fibrous and pearl. Sometimes a combination of both is also found. The LECs that line the anterior capsule are believed to be responsible for fibrous PCO. Clinically it is seen as a wrinkling on the posterior capsule at the site of fusion of the anterior and posterior capsules. Most cases of PCO occur because of proliferation and migration of remaining lens epithelial cells and its derivatives.

The treatment for PCO is surgery or LASER (Light Amplification by Stimulated Emission of Radiation) Before the development of Nd:YAG laser, PCO was dealt with surgical discussion of posterior capsule. Complications of this procedure were those that might be expected from such an invasive surgery and included endophthalmitis, corneal endothelial cell loss and vitreous loss.

Now a days in PCO, Nd: YAG laser is used by avoiding such complications of surgical discussion. The pulsed Nd: YAG laser is a revolutionary approach to PCO. For the past two decades, Nd: YAG laser posterior capsulotomy has been the preferred mode of treatment for any opacification of posterior - This is an outpatient procedure that clears visual axis and improves instantaneously and is not associated with complications of intraocular surgery. However, small percentage of patients develops reopacification of posterior capsular opening after initial successful[2,3] treatment. Nd: YAG laser posterior capsulotomy results in improved vision in 83% to 96% of eyes.[4] Despite the wide range of reported complications Nd: YAG laser has become a preferred mode of treatment for PCO. Hence study of PCO and its treatment by Nd: YAG is clinically relevant.

AIMS AND OBJECTIVES

- To study the clinical Profile of Posterior Capsular Opacification in rural area
- To study the visual outcome after treatment with Nd-YAG Laser Capsulotomy

MATERIALS AND METHODS

The study was conducted over a period of 2 years from September 2019 to August 2020. It was a prospective observation study. All the patients who were diagnosed to have Posteior capsular opacification (PCO) were included in the study. Those who had undergone laser treatment for PCO in the same eye were excluded from the study. In all, 70 eyes were included in the study.

Methodology

Patients presenting to Ophthalmology OPD of Pravara Rural Hospital with PCO underwent a complete ophthalmic evaluation:

- Complete Ophthalmic History
- Determination of Visual Acuity using Snellen's chart
- Torchlight examination, noting the pupillary reflex.
- IOP estimation with Goldman Applanation Tonometer
  - Goldman Applanation Tonometer is a Gold standard for measuring the Intra Ocular Pressure; It Measures the force necessary to flatten a small, standard area of the comea (3.06 mm2).
- Slit lamp examination
  - Dilatation of Pupil with Tropicamide & Phenylephrine for proper visualization of the PCO & PCIOL.
    - Complete anterior segment examination
    - PCO evaluation
      - Type of PCO was noted
    - PCIOL evaluation
      - Type of PCIOL material was noted
      - Type of Edge of optic was noted
      - Type of Capsulotomy was noted
- Fundus Examination with +90 D lens on Slit Lamp Biomicroscopy.

OBSERVATIONS & RESULTS

The present study was conducted in the department of ophthalmology, Prakash Institute of Medical Sciences, Urun Islampur during the period of September 2019 to August 2020.
70 eyes of 70 patients of posterior capsular opacification (PCO) undergoing Nd: YAG laser posterior capsulotomies were studied.

The following observations were made:

Sex	Number of patients	Percentage
Male	38	54.28%
Female	32	45.71%
Total	70	100%

Table 1: Sex wise distribution of the patients of PCO. (n=70)

Table no. 1 shows the sex distribution, in which 54.28% were males and the rest 45.71% were females.

The table no. 2 shows the age distribution of the total cases under the study. The mean age was 58.82 (± 9.61) years and the most of the patients i.e., 51.42% were in the age group of 60-70 years.

Age	Number of Patients	Percentage
≤40	10	14.28%
40-50	4	5.71%
50-60	12	17.14%
60-70	36	51.42%
>70	8	11.42%
Total	70	100%

Table 2: Age wise distribution of PCO patients under the study. (n=70)

Duration after Surgery	Number of Patients	Percentage
≤ 6 months	6	8.57%
6-12 months	17	24.28%
12-24 months	28	40%
≥ 24 months	19	27.14%
Total	70	100%

Table 3: Distribution of patients of PCO according to time of presentation after cataract surgery. (n=70)

The average time of presentation after cataract surgery was 17.42 (± 2.54) months and ranged from 4 months to 5 years. Most of the patients ie. 40% presented between 12-24 months post operatively. While 8.57% presented within 6 months of surgery.

Type of Capsulotomy	Number of Patients	Percentage
CCC	46	65.71%
Can Opener	21	30.00%
Envelope	3	4.28%
Total	70	100%

Table 4: Distribution of type of Capsulotomy in the eyes of patients with PCO. (n=70)

Table no. 4 showing the type of capsulotomies encountered during the time of study. Most of the patients i.e., 65.71% had *continuous curvilinear capsulorhexis (CCC). 30.00% of the patients had Can opener and the remaining 4.28% of patients had envelope type of capsulotomy.*

Type of PCIOL	Number of Patients	Percentage
PMMA	51	72.85%
Acrylic	19	27.14%
Total	70	100%

Table 5: Distribution of type of PCIOL in the eyes of patients with PCO. (n=70)

Table no. 5 shows the type of PCIOL which were encountered during the study. 72.85% of the patients were found to have PMMA PCIOL and the rest 27.14% of the patients were found to have Acrylic PCIOL.

Type of Acrylic IOL	Number of Patients	Percentage
Hydrophilic	15	78.94%
Hydrophobic	4	21.05%
Total	19	100%

Table 6: Distribution of type of Acrylic PCIOL in the eyes of patients with PCO (n=19)

Table no. 6 shows the type of Acrylic PCIOL encountered during the study. Out of the 19 Acrylic PCIOLs, 78.94% were found to be hydrophilic and 21.05% were found to be hydrophobic.

Type of Edge of IOL	Number of Patients	Percentage
Round	46	65.71%
Square	24	34.28%
Total	70	100%

Table 7: Distribution of type of Edge of the PCIOL in eyes of patients with PCO. (n=70)

Table no. 7 showing the type of the edge of the PCIOL encountered during the study. 65.71% PCIOLs were found to have round edges and the remaining 34.28% were found to have square edges.

Type of PCO	Number of Patients	Percentage
Fibrous	30	42.85%
Elsching	25	35.71%
Mixed	15	21.42%
Total	70	100%

Table 8: Distribution of the type of PCO. (n=70)

Table no. 8showing the types of PCO with which the patients presented with. Fibrous type of PCO was found to be the commonest (42.85%) closely followed by Elshing type (35.71%). 21.42% of patients were found to have a mixed type of PCO.

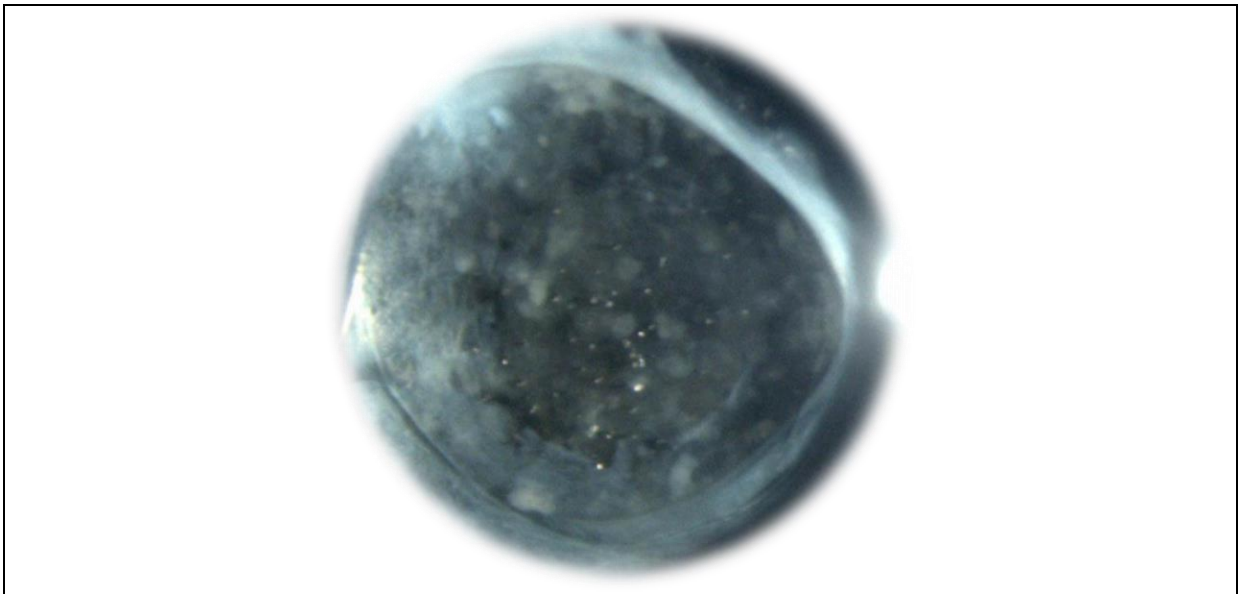

Figure 1: Fibrous type of PCO

Figure 2: Elschnig "Pearl" form of PCO

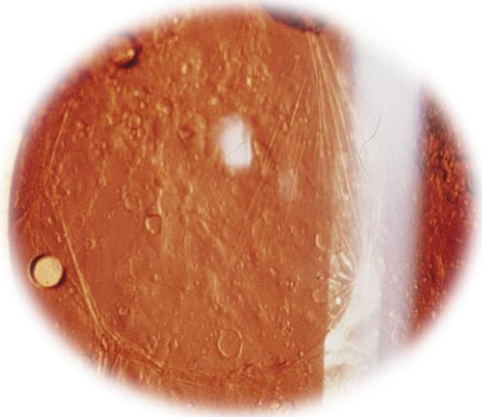

Figure 3: Mixed form of PCO

DISCUSSION

Posterior capsule opacification (PCO) is the most common long-term complication following extracapsular cataract extraction and phacoemulsification. The reported incidence of PCO ranges from 18% to 50%, with most cases developing within two years after surgery. PCO occurs due to proliferation, migration, and metaplasia of residual lens epithelial cells (LECs), resulting in fibrotic changes and wrinkling of the posterior capsule, which clinically manifests as reduced visual acuity, glare, and decreased contrast sensitivity.[5,6] In the present study, 70 eyes of 70 patients undergoing Nd:YAG posterior capsulotomy were evaluated. A slight male predominance (54.28%) was observed. However, gender has not been shown to significantly influence the development of PCO, a finding consistent with earlier reports.[1]

Age Distribution

The mean age of patients in our study was 58.82 ± 9.61 years, comparable to the findings of Ando et al., who reported a mean age of 61.6 years.[4] The majority of patients (51.42%) belonged to the 61–70-year age group. Previous studies have demonstrated that children and young adults are more susceptible to PCO, with pediatric cataract surgery showing an incidence approaching 100%, as reported by Pandey et al.[7] Hiles and Watson similarly reported a higher tendency for

PCO formation in younger patients.[8] The decline in PCO incidence with advancing age is attributed to reduced mitotic activity of LECs.[6] The predominance of elderly patients in our study likely reflects the higher prevalence of senile cataracts in the population attending the outpatient department.

Time of Presentation of PCO

The mean interval between cataract surgery and presentation with PCO in our study was 17.42 ± 2.54 months, ranging from 4 months to 5 years. This finding is comparable to the study by Wang et al., who reported a mean interval of 14 ± 6 months.[9] Most patients (40%) presented between 13 and 24 months postoperatively, while a smaller proportion (8.57%) presented within 6 months of surgery. Maltzan et al. reported that the risk period for requiring Nd:YAG capsulotomy is influenced by the patient's age at the time of cataract surgery, with elderly patients having a prolonged risk period.[10] Ando et al. reported a longer mean referral time of 32.7 months, indicating that variability in PCO development may be influenced by factors such as quality of cortical cleanup, in-the-bag IOL fixation, and IOL design.[4]

Type of Capsulotomy

In the present study, continuous curvilinear capsulorhexis (CCC) was performed in 68.57% of cases, while 31.42% underwent can-opener capsulotomy. Aminollah et al. demonstrated that CCC significantly reduces the incidence of PCO compared to envelope or can-opener techniques.[11] The predominance of CCC in the present study reflects its widespread acceptance as the preferred capsulotomy technique in modern cataract surgery.

Type of Posterior Chamber Intraocular Lens

In our study, 72.85% of eyes had PMMA PCIOLs, while 27.14% had acrylic PCIOLs. Hayashi et al. reported that PCO was more extensive with PMMA IOLs compared to silicone and acrylic IOLs, resulting in greater visual acuity loss.[2] Similar findings were reported by Rönbeck et al. in a five-year prospective study, where PMMA IOLs were associated with higher PCO rates.[3] Oner et al. concluded that acrylic IOLs offer a significant advantage in reducing PCO incidence compared to PMMA lenses.[12]

The reduced incidence of PCO with hydrophobic acrylic IOLs has been attributed to their bioadhesive surface, which promotes close contact between the IOL and the posterior capsule, thereby limiting LEC migration.[13] This concept forms the basis of the "sandwich theory", which suggests that adhesion between the anterior capsule, residual LECs, and the IOL optic creates a barrier to further LEC proliferation behind the optic.[14]

Type of Acrylic PCIOL

Among the acrylic PCIOLs, 78.94% were hydrophilic and 21.05% were hydrophobic. Vasavada et al. reported significantly lower PCO rates with hydrophobic acrylic IOLs compared to hydrophilic acrylic IOLs at three-year follow-up.[15] Kugelberg et al. observed greater PCO severity and area with hydrophilic acrylic IOLs at one year postoperatively.[16] Iwase et al. similarly reported lower PCO rates, reduced capsulotomy rates, and better visual acuity in eyes implanted with hydrophobic acrylic IOLs at two years.[17]

Edge Design of PCIOL

In the present study, **65.71%** of PCIOLs had **round edges**, while **34.28%** had **square edges**. Shah et al. demonstrated that square-edged PMMA IOLs significantly reduce the area and severity of PCO compared with round-edged designs.[18] Hazra et al. also reported a higher incidence of PCO with round-edged rigid lenses.[19] Nishi et al. proposed that square-edged optics produce a sharp capsular bend, which acts as a mechanical barrier to LEC migration.[20]

Mathematical models further support this mechanism, suggesting that square-edged optics exert higher pressure on the posterior capsule, thereby inhibiting LEC migration.[21] Peng et al., in a histopathological study, confirmed that truncated square-edged IOLs provide maximal inhibition of cell growth behind the optic.[22]

Type of PCO

In the present study, fibrous PCO was the most common type (42.85%), followed by Elschnig pearl type (35.71%). Mixed and Soemmering ring types were less frequent. Qaim et al. reported a higher incidence of fibrotic PCO compared to Elschnig pearls, a finding consistent with the present study.[23] Similar observations were made by Kuasar et al.[24]

CONCLUSION

Our study "Clinical Profile of Posterior Capsular Opacification" was a prospective observational study carried out in a tertiary care centre in a rural area over a period of 2 years from September 2019 to August 2020.

After studying the clinical profile of 70 eyes of 70 patients, we found that Eyes with the PMMA IOL are at higher risk of developing PCO than eyes with the Acrylic IOLs. PCO is significantly less with the hydrophobic acrylic intraocular lenses compared to hydrophilic acrylic intraocular lenses. Square, truncated optic edge seem to provide the maximum impediment to development of PCO.

Authors Contribution

1. Dr. Kunal Patil -Conceptualization, Investigation, Case Management, Supervision, Writing - Review & Editing.
2. Dr. Krishna Nalawade - Patient Management, Writing - Original Draft Preparation.
3. Dr. Varsha Patil - Literature Review, Writing - Original Draft Preparation.

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