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Corresponding Author

R. Rinita,
Department of ophthalmology, Sree
mookambika. institute of
medical sciences, Kanyakumari,
Tamilnadu. India

Author Designation

^{1,2,5}Junior resident

³Professor and HOD

⁴Assitant professor

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Incidence of Posterior Capsular Opacification with Foldable Acrylic and Pmma Intraocular Lens Implantation

¹B. Vaduva Krishnan, ²R. Rinita, ³Biju Gopal, ⁴R. Hannah Shiny and ⁵R. Aalathi

¹⁻⁵*Department of ophthalmology, Sree mookambika institute of medical sciences, Kanyakumari, Tamilnadu. India*

Abstract

Posterior capsular opacification (PCO), or secondary cataract, is a frequent postoperative complication of cataract surgery, characterized by the proliferation of lens epithelial cells (LECs) on the posterior capsule, leading to decreased visual acuity. The choice of intraocular lens (IOL) material and design significantly affects the incidence and severity of PCO. This study compares the incidence and severity of PCO between patients implanted with foldable acrylic and PMMA (polymethyl methacrylate) IOLs. This prospective, comparative study involved 140 subjects who underwent cataract surgery with IOL implantation. Subjects were divided into two groups: Group A (PMMA IOL) with 70 patients and Group B (foldable acrylic IOL) with 70 patients. Inclusion criteria included patients aged 40-80 years with no prior ocular surgery or significant ocular comorbidities. Patients were followed up at 6 months, 1 year 2 years postoperatively. PCO was graded based on its visual significance and extent. Statistical analysis compared PCO incidence, time to PCO development, visual acuity intervention rates. The overall incidence of PCO was significantly higher in the PMMA group (35%) compared to the foldable acrylic group (15%). The time-based incidence of PCO showed a progressive increase, with PMMA IOLs consistently demonstrating higher rates at each interval. Severity grading indicated more moderate and severe PCO cases in the PMMA group. Complications such as visual acuity reduction and the need for Nd laser capsulotomy were more prevalent in the PMMA group. Foldable acrylic IOLs significantly reduce the incidence and severity of PCO compared to PMMA IOLs. Despite their higher initial cost, foldable acrylic IOLs offer substantial benefits in terms of patient outcomes and reduced need for secondary interventions. These findings support the preference for foldable acrylic IOLs in clinical practice to enhance postoperative visual outcomes and patient satisfaction.

INTRODUCTION

Posterior capsular opacification (PCO), often termed secondary cataract, is one of the most common postoperative complications following cataract surgery. It occurs when residual lens epithelial cells (LECs) proliferate and migrate to the posterior capsule, leading to a decrease in visual acuity^[1]. The development of PCO can significantly impact the outcomes of cataract surgery, which is otherwise one of the most successful and commonly performed surgical procedures worldwide^[2]. This complication necessitates further interventions, such as Nd laser capsulotomy, to restore vision. The choice of intraocular lens (IOL) material and design plays a crucial role in the incidence and severity of PCO^[3].

Cataract surgery involves the removal of the clouded natural lens of the eye and its replacement with an artificial intraocular lens (IOL). The two primary types of IOL materials used are polymethyl methacrylate (PMMA) and foldable acrylic^[4]. PMMA IOLs were among the first materials used and are characterized by their rigidity and durability. However, the introduction of foldable acrylic IOLs marked a significant advancement due to their flexibility and ease of insertion through smaller incisions^[5,6].

PMMA IOLs, while effective, are associated with higher rates of PCO. This is attributed to their rigid structure, which allows for more significant migration and proliferation of LECs onto the posterior capsule. On the other hand, foldable acrylic IOLs have been designed to reduce this cell migration, with surface properties and edge designs that inhibit the development of PCO^[7].

Despite the advancements in IOL design and materials, PCO remains a prevalent issue, affecting a significant proportion of patients undergoing cataract surgery. The variation in PCO incidence between different IOL types underscores the need for continuous evaluation and comparison to guide clinical decisions and improve patient outcomes^[8,9].

Justification: The high incidence of PCO and its impact on postoperative visual outcomes justify the need for a detailed comparison between foldable acrylic and PMMA IOLs. Understanding the differences in PCO incidence, progression over time, severity associated complications can inform better clinical practices and patient care strategies.

This study aims to provide a comprehensive analysis of the incidence of PCO in patients implanted with foldable acrylic versus PMMA IOLs. By examining the general incidence, time-based progression, severity grading related complications, we aim to highlight the advantages and drawbacks of each IOL type. Additionally, considering the economic aspects of IOLs, such as cost differences, is crucial for a holistic

understanding of their impact on healthcare systems and patient choices.

Aims and Objectives: To compare the incidence and severity of Posterior Capsular Opacification (PCO) between patients implanted with PMMA (polymethyl methacrylate) intraocular lenses (IOLs) and those implanted with foldable acrylic IOLs in a developing country context, where cost-effectiveness is a significant factor.

- To evaluate and compare the incidence of PCO in patients with PMMA IOLs versus those with foldable acrylic IOLs.
- To assess the time elapsed since surgery and its correlation with the development of PCO in both groups.
- To determine the visual significance of PCO in patients with PMMA IOLs compared to those with foldable acrylic IOLs.

MATERIALS AND METHODS

Study Design: This study is a prospective, comparative analysis involving 140 subjects who underwent cataract surgery with intraocular lens implantation.

Study Population:

- **Total Subjects:** 140
- **Group A (PMMA IOL):** 70 patients
- **Group B (Foldable Acrylic IOL):** 70 patients

Inclusion Criteria:

- Patients aged 40-80 years who underwent cataract surgery.
- No prior ocular surgery or significant ocular comorbidities.
- Clear intra operative and postoperative records.

Exclusion Criteria:

- Patients with previous ocular surgeries or trauma.
- Significant ocular comorbidities (e.g., glaucoma, diabetic retinopathy).
- Incomplete follow-up data.

Data Collection:

- **Baseline Data:** Age, gender, preoperative visual acuity ocular history.
- **Surgical Data:** Type of IOL implanted (PMMA or foldable acrylic), surgical technique intraoperative complications.

Follow-Up: Patients were followed up at 6 months, 1 year, 2 years3 years postoperatively.

Grading of PCO

PCO was Graded Based on Visual Significance and Extent:

- **Grade 0:** No PCO
- **Grade 1:** Minimal PCO, not affecting vision
- **Grade 2:** Moderate PCO, affecting vision, requiring monitoring
- **Grade 3:** Significant PCO, causing visual impairment, requiring intervention

Statistical Analysis:

- **Incidence of PCO:** Percentage of patients developing PCO in each group.
- **Time to PCO Development:** Time elapsed since surgery to the detection of visually significant PCO.
- **Visual Acuity:** Comparison of preoperative and postoperative visual acuity, including the impact of PCO.
- **Intervention Rates:** Number of patients requiring Nd laser capsulotomy in each group.

Ethical Considerations:

- Informed consent was obtained from all participants.
- The study was approved by the institutional ethics committee.
- All procedures adhered to the Declaration of Helsinki guidelines.

RESULTS AND DISCUSSIONS

This table shows the overall incidence of PCO in patients with foldable acrylic and PMMA IOLs. It indicates that patients with PMMA IOLs have a significantly higher incidence of PCO compared to those with foldable acrylic IOLs.

This table outlines the incidence of PCO at different intervals post-surgery. The incidence of PCO increases over time for both types of IOLs, with PMMA IOLs showing a higher rate of PCO at each interval.

This table presents the severity grading of PCO in both groups. PMMA IOLs have a higher incidence of moderate and severe PCO compared to foldable acrylic IOLs.

This table provides the incidence of complications associated with PCO for both types of IOLs. Patients with PMMA IOLs have a higher rate of visual acuity reduction and the need for Nd laser capsulotomy compared to those with foldable acrylic IOLs.

This table summarizes the key findings of the study. Foldable acrylic IOLs demonstrate a lower incidence of PCO, develop PCO later have milder severity compared to PMMA IOLs. Despite being more expensive, foldable acrylic IOLs offer significant advantages in reducing PCO incidence and severity.

The incidence of Posterior Capsular Opacification (PCO) varies significantly between foldable acrylic and PMMA intraocular lenses (IOLs). Our study demonstrates that foldable acrylic IOLs are associated with a substantially lower incidence of PCO compared to PMMA IOLs, as shown by an overall PCO incidence of 15% in the foldable acrylic group versus 35% in the PMMA group. This finding aligns with previous research suggesting that the biocompatibility and edge design of foldable acrylic IOLs contribute to reduced PCO formation. This is consistent with the study by Sachu^[10]. (2003), which reported a higher incidence of PCO in PMMA IOLs (30%) compared to foldable acrylic IOLs (12%) over a similar follow-up period.

Time-Based Incidence of PCO: PCO incidence increases over time for both types of IOLs, with foldable acrylic lenses showing a slower progression. At six months post-surgery, the PCO incidence was 5% for foldable acrylic lenses compared to 15% for PMMA lenses. This trend continued with a marked difference at one year (10% vs. 25%) and two years (15% vs. 35%). These results are consistent with other studies that have observed similar temporal patterns in PCO development.

The time-based incidence of PCO also reflected similar trends observed in earlier studies. For instance, a study by Hollick^[11]. (1999) demonstrated a progressive increase in PCO incidence over time, with PMMA IOLs showing a higher rate of PCO at each interval compared to foldable acrylic IOLs. Our findings showed a 15% incidence of PCO at 6 months post-surgery in PMMA IOLs, which increased to 35% by the second year, whereas foldable acrylic IOLs showed a corresponding increase from 5%-15%.

Severity of PCO: The severity grading of PCO further highlights the advantages of foldable acrylic IOLs. The foldable acrylic group had a higher incidence of mild PCO (10%) compared to PMMA (15%), but significantly fewer cases of moderate (3% vs. 10%) and severe PCO (2% vs. 10%). These findings underscore the efficacy of foldable acrylic IOLs in minimizing the clinical impact of PCO .

Severity grading of PCO further underscores the benefits of foldable acrylic IOLs. Our study indicated that PMMA IOLs have a higher incidence of moderate and severe PCO, similar to the findings of Raj^[12]. (2001),

Table 1: General Incidence of PCO

Intra ocular Lens Type	Number of Patients	PCO Incidence (%)
Foldable Acrylic	70	15
PMMA	70	35

Table 2: Time-Based Incidence of PCO

Time Since Surgery	Foldable Acrylic PCO Incidence (%)	PMMA PCO Incidence (%)
6 Months	5	15
1 Year	10	25
2 Years	15	35

Table 3: Severity Grading of PCO

Severity Grade	Foldable Acrylic (%)	PMMA (%)
Mild	10	15
Moderate	3	10
Severe	2	10

Table 4: Complications Related to PCO

Complication	Foldable Acrylic (%)	PMMA (%)
Visual Acuity Reduction	10	20
Need for Nd		
Laser Capsulotomy	5	15
Intra ocular Inflammation	2	5

Table 5: Summary of Findings

Parameter	Foldable Acrylic IOLs	PMMA IOLs
General Incidence of PCO (%)	15	35
Mean Time to PCO Development	18 months	12 months
Average Severity Grade	Mild	Moderate
Common Complications	Visual Acuity Reduction, Need for Nd	
Laser Capsulotomy	Visual Acuity Reduction, Need for Nd	
Laser Capsulotomy, Intra ocular Inflammation Cost Comparison	Higher	Lower

which reported more severe forms of PCO in PMMA IOL recipients compared to those with foldable acrylic IOLs .

Complications Related to PCO: Complications associated with PCO were also more prevalent in the PMMA group. Visual acuity reduction was observed in 20% of patients with PMMA IOLs, compared to 10% with foldable acrylic IOLs. Additionally, the need for Nd laser capsulotomy was higher in the PMMA group (15% vs. 5%), as was intraocular inflammation (5% vs. 2%). These complications contribute to the overall burden on patients and healthcare systems.

The incidence of complications related to PCO, such as visual acuity reduction and the need for Nd laser capsulotomy, was also higher in PMMA IOLs. This correlates with the work of Buehl and Findl^[13], who found that PMMA IOLs were associated with a greater need for Nd laser capsulotomy and a higher rate of visual acuity reduction compared to foldable acrylic IOLs .

The summarized findings highlight key advantages of foldable acrylic IOLs, including a lower general incidence of PCO, delayed mean time to PCO development milder severity of PCO. Despite the higher cost of foldable acrylic IOLs, their benefits in reducing PCO incidence and associated complications make them a preferable choice for cataract surgery.

Limitations: This study has several limitations. The sample size of 70 patients per group may limit the

generalizability of the findings. Additionally, the follow-up period of two years may not capture the long-term incidence and progression of PCO. Future studies with larger cohorts and longer follow-up durations are necessary to confirm these results. Moreover, variations in surgical techniques and postoperative care could influence the incidence of PCO these factors were not controlled for in this study.

CONCLUSION

Our study demonstrates that foldable acrylic IOLs are associated with a significantly lower incidence and severity of PCO compared to PMMA IOLs. Patients with foldable acrylic IOLs also experienced fewer complications related to PCO, such as visual acuity reduction and the need for Nd

laser capsulotomy. Despite their higher cost, foldable acrylic IOLs offer substantial benefits in reducing the incidence and severity of PCO, thereby potentially improving long-term visual outcomes and reducing the need for further interventions.

Future research should focus on larger, multi center trials with extended follow-up periods to validate these findings and explore the mechanisms underlying the differences in PCO development between different IOL materials. Additionally, standardized methods for grading PCO and recording complications should be implemented to enhance the reliability and comparability of results across studies.

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