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RESEARCH ARTICLE
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RELATIONSHIP BETWEEN INTRAOPERATIVE COMPLICATIONS OF CATARACT SURGERY AND AXIAL LENGTH: A RETROSPECTIVE STUDY

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ABSTRACT

Background

Axial length variation influences cataract surgery outcomes and complication rates. This study evaluates intraoperative complications across three axial length groups (<21mm, 22-25mm, >25mm).

Methods

A retrospective analysis of 84 eyes from 84 patients who underwent phacoemulsification with intraocular lens (IOL) implantation between January 2023 and December 2024. Patients were grouped by axial length: Group A (<21mm), Group B (22-25mm), and Group C (>25mm). Main outcomes included intraoperative complications.

Results

Group A had significantly higher complication rates (75%) compared to Groups B (18%) and C (32%) ($p<0.001$). The most frequent complications in Group A were iris prolapse, posterior capsule (PC) rent, and Descemet's membrane tears. Normal intraoperative findings were observed in 25% of Group A, 82% of Group B, and 68% of Group C.

Conclusion

Cataract surgery in short eyes (axial length <21mm) poses greater intraoperative challenges and higher complication rates. Adequate preoperative planning and experienced surgical hands are essential in such cases.

Keywords

Axial Length, Cataract Surgery, Intraoperative Complications, Posterior Capsule Rent, Iris Prolapse.

INTRODUCTION

Cataract surgery is one of the most commonly performed ophthalmic procedures worldwide and has evolved significantly with advancements in surgical techniques and technology. Despite its high success rate, intraoperative complications can still occur, potentially affecting visual outcomes and

patient satisfaction. Among various patient-specific factors, axial length of the eye has been increasingly recognized as a critical variable influencing the risk profile during cataract surgery.[1]
Eyes with extreme axial lengths, either very short (nanophthalmic) or very long (highly myopic), present unique anatomical and physiological challenges that can predispose them to complications such as posterior capsular rupture, zonular dialysis, or vitreous loss.[2] A study found that posterior capsule rupture (PCR) rates during cataract surgery were generally consistent across axial lengths, except in eyes with axial length <20.0 mm, where the PCR risk was 1.9 times higher, with an overall rate of 3.6%.[3] Conversely, shorter axial lengths may lead to crowded anterior segments and a higher risk of iris prolapse, Descemet's membrane and/or endothelial trauma, transient severe corneal edema and cystoid macular edema.[4] Understanding the relationship between axial length and intraoperative complications is crucial for risk stratification, surgical planning, and improving patient outcomes. Prior studies have documented higher complication rates in such eyes, including uveal effusion, posterior capsule rupture, and iris prolapse.[5] Predictability of refractive outcomes is also compromised in short eyes due to limitations in IOL power calculation formulae.[6,7]

This study aims to investigate the correlation between axial length variations and the frequency or severity of intraoperative complications during cataract surgery, thereby providing evidence to guide preoperative assessment and surgical approach and analyzes intraoperative complications across three axial length categories.

OBJECTIVES

1. To document the types of intraoperative complications.
2. To determine the correlation between axial length and the risk of specific intraoperative complications.

MATERIALS AND METHODS

Study Site

This retrospective study is conducted in the department of Ophthalmology at R.L.J. Hospital and Research Centre, Kolar attached to Sri Devaraj Urs Medical College over a period of 2 years from January 2023 to December 2024.

Study Design

This is a hospital based retrospective study which included in-patients admitted in Ophthalmology Department in R.L. Jalappa Hospital, Kolar.

Inclusion Criteria

1. Age ≥ 40 years
2. Documented preoperative axial length
3. Complete surgical records

Exclusion Criteria

1. History of prior intraocular surgery
2. Ocular trauma
3. Inflammatory eye disease
4. Pseudoexfoliation
5. Small pupil
6. Complicated cataract
7. History of Glaucoma

Pre-operative data will include age, sex, detailed ophthalmological workup, biometry, medical co-morbidities, and use of any medications.

Study Approval

The study approval has been obtained from Institutional Research and ethics Committee, at Sri Devaraj Urs Medical College, Tamaka, Kolar before the initiation of the study.

Medical records of 84 patients undergoing Small incision cataract surgery with IOL implantation between January 2023 and December 2024 were reviewed. Patients were grouped based on axial length into:

- Group A: <21mm
-Group B: 22-25mm
- Group C: >25mm

Preoperative variables included age, gender, axial length, and ocular comorbidities. Intraoperative data included complication types: iris prolapse, PC rent, vitreous loss, Descemet's tear, iridodialysis, and sulcus placement of IOL.

Statistical Analysis

Data were entered and analyzed using SPSS version 25.0. Categorical variables such as the presence or absence of specific complications across axial length groups were compared using the Chi-square test or Fisher's exact test where appropriate, based on expected cell frequencies. Logistic regression analysis was used to determine whether axial length was an independent predictor of intraoperative complications, adjusting for age and gender. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Patient Demographics: Mean age was 69.2 ± 6.6 years (range: 55-82 years). Of the 84 patients, 50 (59.5%) were male and 34 (40.5%) were female.[8]

Intraoperative Complications: Complications were highest in Group A (Table 1). Iris prolapse and PC rent were predominant in Group A, while Groups B and C had fewer complications (Figure 1).

Complication	Group A (n=28)	Group B (n=28)	Group C (n=28)
Iris prolapse	6 (21.4%)	2 (7.1%)	2 (7.1%)
Posterior capsule rent	3 (10.7%)	1 (3.5%)	1 (3.5%)
Vitreous loss	3 (10.7%)	0	1 (3.5%)
Descemet's tear	3 (10.7%)	1 (3.5%)	1 (3.5%)
Iridodialysis	3 (10.7%)	0	2 (7.1%)
Sulcus placement of IOL	3 (10.7%)	1 (3.5%)	2 (7.1%)
No complications	7 (25%)	23 (82%)	19 (67.8%)

Table 1

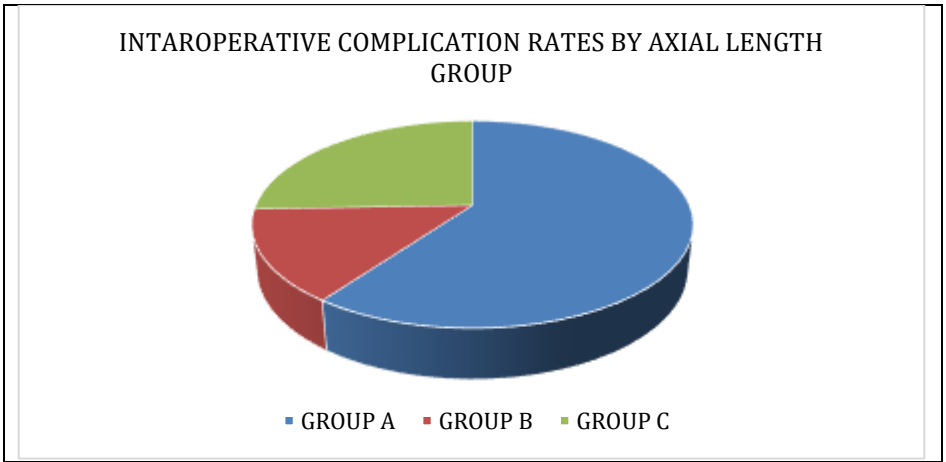

Figure 1: Intraoperative Complication rates by axial length group

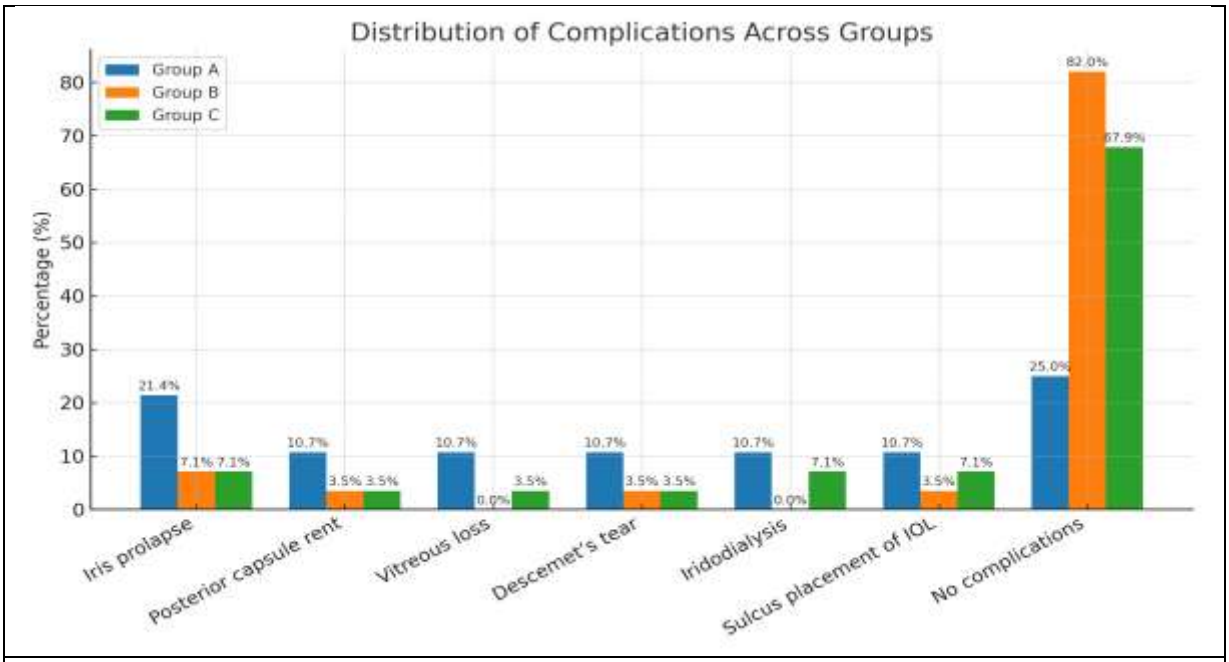

Figure 2: Percentage distribution of intraoperative complications across axial length groups

DISCUSSION

In this retrospective analysis of 84 eyes undergoing cataract surgery with intraocular lens implantation, we observed a markedly higher rate of intraoperative complications in eyes with axial length <21 mm (Group A) compared to those with normal (22–25 mm, Group B) and long (>25 mm, Group C) axial lengths.[9-11] Specifically, two-thirds of short eyes experienced one or more complications-most commonly iris prolapse (21.4%) and posterior capsule rent (10.7%)-whereas nearly 80% of normal and over 60% of long eyes were complication-free.

These findings reinforce previous reports that anatomical constraints in short eyes, such as a shallow anterior chamber, reduced working space, increased positive vitreous pressure, and thicker sclera, predispose to intraoperative challenges.[4,9] Yosar et al. documented similar high rates of uveal effusion and posterior capsule rupture in nanophthalmic eyes, attributing this to small ocular volume and limited chamber depth.[4] Hoffman et al. likewise reported that the combination of a tight chamber and increased iris–lens diaphragm mobility in short eyes elevates the risk of iris prolapse and capsular tears.[9]

By contrast, eyes with longer axial lengths (>25 mm) tend to have deeper chambers and more lax zonular support, which, while posing their own challenges-such as zonular dehiscence in high myopes-nonetheless yielded fewer major complications in our cohort. Jin et al. demonstrated that extremely myopic eyes can be managed safely with tailored techniques, but warned of late postoperative complications such as IOL decentration.[12]

Clinical Implications

Given the high complication profile in short eyes, meticulous preoperative evaluation is essential. Surgeons should consider:

- **Anterior chamber maintenance**: Use of cohesive viscoelastics and careful incision construction to prevent chamber collapse and iris prolapse.[2,3]
- **Capsulorhexis technique**: Smaller, well-centered rhexis with modified forceps or femtosecond-assisted capsulotomy to reduce stress on the capsule.[13]
- **IOL selection and power calculation**: Employ modern formulae (e.g., Barrett Universal II, Hoffer Q) validated in short eyes to minimize refractive surprises.[6]

- Use of modern surgical techniques and preoperative prophylactic measures such as anterior vitrectomy may reduce risks.[14,15]

LIMITATIONS

This study's retrospective design and relatively small sample size in each group limit the generalizability of our findings. Selection bias may exist, as more complex short-eye cases might have been referred to experienced surgeons. Additionally, we did not stratify by lens opacification grade or surgeon experience, both of which can influence complication rates.

FUTURE Directions

Prospective multicenter studies with standardized surgical protocols are warranted to validate risk-reduction strategies in short eyes. Investigation into the role of intraoperative imaging (e.g., real-time anterior segment OCT) and novel viscoadaptive devices may further mitigate complications. Finally, long-term refractive and anatomical outcomes in this challenging cohort should be explored.

CONCLUSIONS

Cataract surgery in eyes with axial length <21 mm carries a significantly elevated risk of intraoperative complications. Awareness of these risks, combined with tailored surgical planning and technique modifications, is crucial to optimize patient safety and visual outcomes.

Despite its limitations, including retrospective design, limited sample size, and potential referral bias, this study contributes valuable data to the growing body of literature on axial length-related surgical risk. It emphasizes that short eyes, though less common, warrant heightened intraoperative caution and individualized surgical strategies.

In summary, axial length is not merely a biometric parameter but a critical surgical risk factor. Surgeons should recognize short eyes (<21 mm) as a high-risk group for intraoperative complications during cataract surgery and implement proactive measures to enhance safety and visual prognosis. Continued research and innovation are essential to refine surgical techniques and improve outcomes in this challenging subset of patients.

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