



ORIGINAL RESEARCH PAPER

Ophthalmology

A STUDY ON SMALL INCISION CATARACT SURGERY IN SMALL PUPIL

KEY WORDS: Small Pupil, Cataract Surgery, SICS, Intraoperative Complications, Pupil Dilation

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ABSTRACT	Purpose: To evaluate the factors associated with non-dilating small pupil and intraoperative complications in patients undergoing Small Incision Cataract Surgery (SICS). Methods: This prospective study was conducted in the Department of Ophthalmology, Silchar Medical College and Hospital, from February to September 2024. A total of 40 patients with small pupil (≤ 4 mm after maximal pharmacological dilation) were included. Exclusion criteria were glaucoma on pilocarpine and systemic neurological conditions. All patients underwent SICS, and data regarding demographics, causes of small pupil, intraoperative complications, management strategies, and postoperative outcomes were analyzed. Results: Of the 40 patients, 52.5% were male and 47.5% female, with the majority (61–80 years) affected. Diabetes (30%) was the most common cause of small pupil, followed by atonic pupil in elderly and chronic uveitis (17.5% each). Trauma and pseudoexfoliation accounted for 12.5% each, while intraocular surgery (5%) and idiopathic causes (4%) were less frequent. The most common intraoperative complication was difficulty in nucleus delivery. Intra-cameral epinephrine, viscomydriasis, and synechiolysis were effective management measures. Postoperatively, striate keratopathy was most frequent, followed by uveitis. Conclusion: Adequate pupil dilation with red reflex is vital for safe cataract surgery. Optimizing pharmacological dilation and adapting surgical techniques—such as intra-cameral epinephrine, viscomydriasis, synechiolysis, and iris hooks—enable successful management of small pupil with good visual outcomes. Careful preoperative evaluation and minimal tissue handling reduce complications.
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INTRODUCTION
 Cataract is currently the main cause of avoidable blindness in the developing world accounting for about three quarters of blindness.[1]

One of the most important things in cataract surgery is pupil size. A well dilated pupil with a sharp red reflex enhances the ease of cataract surgery and decreases the likelihood of complications. Keeping in mind that, there are numerous factors leading to poor pupil dilation, smaller than 4mm; including, but not limited to the systemic diseases. Intake of some pharmacological agents, local co-morbidities (glaucoma, ocular trauma, previous ocular surgery, uveitis, etc.)-these eyes are generally more prone to increased permeability of the blood aqueous barrier, leading to postoperative inflammation.[3], [4], [5]

Mydriatic agents dilate the pupil by stimulating the dilator (adrenergic agonists) or by blocking the sphincter (cholinergic blockers). Adrenergic agents increase dilator activity. In few circumstances poor dilation could be due to ineffective dilating drops, poor administration technique or due to expired medication. [6]

Intra-operative floppy iris syndrome (IFIS) is another cause of miosis. Characterized by a flaccid iris which undulates in response to intraocular fluid currents, with a tendency to prolapse towards the area of surgery and may result in damage to the iris by intraocular instruments. [7]

No single approach will address any of the causes involved in poorly dilating pupil, the underlying patho-physiology should be taken into consideration for surgical plan of cataract surgery.

AIMS AND OBJECTIVES

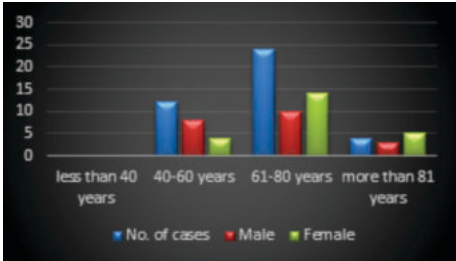
- To determine–
- Factors associated with non-dilating small pupil
 - Intra operative complication associated with small pupil

MEHODOLOGY
 An institutional ethical committee approval was taken by respective partner organization, and the study was conducted from February 2024 to September 2024 in full accord with the tenets of declaration of Helsinki. It was an Observational Prospective study with sampling technique being purposive sampling in all patients who underwent Small Incision Cataract Surgery presenting to outpatient department in our tertiary care center (Silchar Medical College and Hospital). We enrolled 40 patients with small non-dilating pupil planned for Small Incision Cataract Surgery.

- Inclusion Criteria**
- Patients with small pupil (4mm or less after maximal dilation using tropicamide 0.5% and phenylephrine 1% eye drops administered 6 times at 10 min interval)
- Exclusion Criteria**
- Glaucoma patients on pilocarpine
 - Systemic diseases like multiple sclerosis, Alzheimer's disease, Parkinson's disease.

RESULT
 40 patients were recruited and their data was analyzed and graphically presented:

A. Demographic Data-

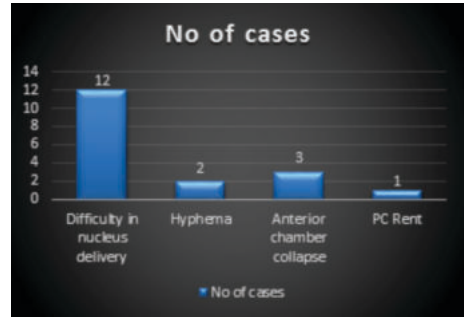


- Out of 40 cases, majority belonged to 61-80 years of age.
- Out of 40 cases, male- 21 and female-19
- Male:Female- 1.1:1

B. Causes of Small Pupil-

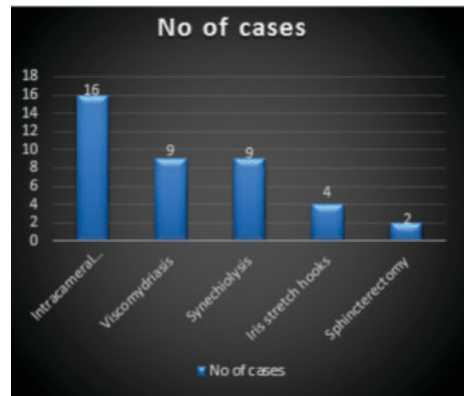
Sl.No	Causes	No. of cases	Percentage
1	Diabetes	12	30%
2	Pseudoexfoliation syndrome	5	12.5%
3	Trauma	5	12.5%
4	Chronic uveitis	7	17.5%
5	Intraocular surgery	2	5%
6	Atonic pupil in elderly	7	17.5%
7	Idiopathic	2	5%

C. Intra Operative Complication:



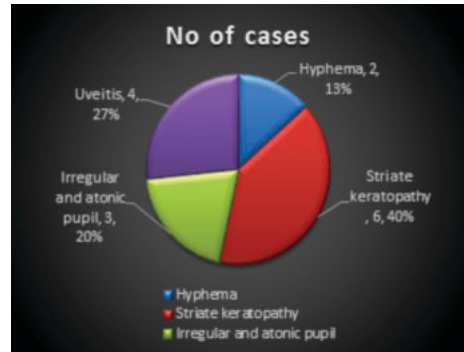
- Out of 40 cases, 18 cases showed intra-operative complications.
- Of these, majority (12 cases) presented with difficulty in nucleus delivery.

4. Intra Operative Management:



- Out of 40 cases,
- 40% (16 patients) were given intracameral epinephrine
 - 22.5% (9 patients) underwent viscomydriasis and another 22.5% underwent synechiolysis

5. Post operative Complications (15 nos)



- Out of 40 patients, 15 had post-op complications:
- Striate keratopathy- 40%
 - Uveitis- 27%
 - Irregular and Atonic pupil- 20%
 - Hyphema- 13%

DISCUSSION

In the present study, the majority of patients belonged to the age group of 61–80 years, indicating that small pupil and its associated surgical challenges are more prevalent among

elderly individuals. This observation correlates well with the known age-related degenerative changes in the iris musculature and the higher prevalence of systemic diseases such as diabetes and pseudoexfoliation syndrome in this population. Advancing age also contributes to decreased pupillary dilatation due to increased rigidity of the iris sphincter and stromal fibrosis.

Gender Distribution

A male preponderance was observed in this study. This may be attributed to the higher cataract surgery rates among males, possibly due to increased outdoor exposure and earlier health-seeking behavior compared to females. However, the gender difference may also reflect regional demographic patterns and healthcare access inequalities.

Causes of Small Pupil

The most common cause of small pupil in our study was diabetes mellitus, accounting for 30% of cases. This finding aligns with previous studies showing that diabetic patients often have impaired autonomic control of the iris, leading to poor mydriasis. Chronic hyperglycemia causes micro-vascular damage and autonomic neuropathy affecting the iris sphincter and dilator muscles.

Atonic pupil in elderly and chronic uveitis each accounted for 17.5% of cases. In elderly individuals, degenerative changes in the iris sphincter result in an atonic pupil that responds poorly to mydriatics. In chronic uveitis, inflammatory adhesions (posterior synechiae) and sphincter fibrosis contribute to poor dilation. Trauma and pseudoexfoliation syndrome were responsible for 12.5% each. In pseudo-exfoliation syndrome, deposition of fibrillar material on the iris and zonules leads to poor mydriasis and increased risk of intraoperative complications. Intraocular surgery accounted for 5%, while idiopathic causes were noted in 4% of cases.

Intraoperative Complications

The most frequently encountered intraoperative difficulty was nucleus delivery, which was particularly challenging in patients with small pupils. Poor visualization of the capsular margin and inadequate working space increase the risk of iris trauma, capsular rupture, and zonular dialysis. In some cases, stretching maneuvers and mechanical dilatation were required to improve pupillary size.

Intraoperative Management

Effective management of small pupils is crucial for successful cataract surgery. In our study, intracameral epinephrine, synechiolysis, and viscomydriasis were the most commonly employed techniques, and were effective in the majority of cases. Intracameral epinephrine acts on the iris dilator muscle to improve mydriasis, while viscomydriasis provides a mechanical separation of the iris from the lens capsule using a cohesive viscoelastic. Synechiolysis was performed in cases with posterior synechiae to release adhesions and facilitate pupil dilation. These methods minimized the need for mechanical pupil expansion devices and reduced intraoperative complications.

Postoperative Complications

The most common postoperative complication observed was striate keratopathy, followed by uveitis. Striate keratopathy is usually transient and results from corneal endothelial touch or prolonged surgical manipulation, especially in cases where the small pupil limits surgical maneuverability. Postoperative uveitis was likely due to iris trauma during surgery or pre-existing inflammatory conditions such as chronic uveitis and pseudoexfoliation. Prompt use of topical corticosteroids and anti-inflammatory agents led to good postoperative recovery in most patients.

Comparison with Previous Studies

Our findings are consistent with earlier studies reporting

diabetes and pseudoexfoliation as leading causes of small pupil during cataract surgery. Similar intraoperative management strategies have been advocated in literature, emphasizing the role of pharmacologic and viscoelastic techniques before resorting to mechanical devices like iris hooks or pupil expansion rings.

CONCLUSION

Adequate pupil dilation with a good red reflex is crucial for performing safe and successful cataract surgery, as it ensures optimal visualization of intraocular structures and facilitates precise surgical maneuvers.

A comprehensive preoperative assessment of the patient's ocular condition — including corneal clarity, anterior chamber depth, degree of dilation, presence of pseudoexfoliation, posterior synechiae, zonular weakness, and overall systemic status — is essential for surgical planning and minimizing intraoperative challenges.

In our study, the use of intracameral epinephrine, viscomydriasis, synechiolysis, and iris stretch hooks proved effective in achieving adequate pupil dilation for cases presenting with small or non-dilating pupils. These techniques provided better exposure of the surgical field and reduced intraoperative difficulties.

It is important to minimize tissue handling and mechanical manipulation of the iris to prevent postoperative complications such as uveitis, hyphema, iris prolapse, and pupil distortion. Gentle and meticulous surgical technique contributes significantly to faster recovery and improved outcomes.

We conclude that optimizing pharmacological and mechanical dilation techniques, combined with appropriate surgical modification, can ensure safe and effective cataract surgery in eyes with small pupils. Adhering to individualized strategies and maintaining intraoperative vigilance are key to achieving excellent visual and anatomical outcomes.

REFERENCES

1. Thylefors B, Negrel A, Pararajasegaram R. Global data on blindness. World Health Organization. 1995;73(1):115-21. [Google Scholar]
2. Singh K, Kathait K, KS. History of cataract surgery. Small incision cataract surgery (manual phaco). 2002. [Google Scholar]
3. Malyugin B. Cataract surgery in small pupils. Indian J Ophthalmol. 2017;65(12):1323-8. [Google Scholar] [Crossref]
4. Yaguchi T, Oshika T, Sawaguchi S, Kaiya T. Pupillary functions after cataract surgery using flexible iris retractor in patients with small pupil. Jpn J Ophthalmol. 1999;43(1):20-4. [Google Scholar] [Crossref]
5. Novak J. Flexible iris hooks for phacoemulsification. J Cataract Refract Surg. 1997;23(6):828-31. [Google Scholar] [Crossref]
6. Narendran N, Jaycock P, Johnston R, Taylor H, Adams M, Tole D. The cataract national dataset electronic multicentre audit of 55,567 operations: Risk stratification for posterior capsule rupture and vitreous loss. Eye (Lond). 2009;23:31-7. [Google Scholar]
7. Masket S. Avoiding complications associated with iris retractor use in small pupil cataract extraction. J Cataract Refract Surg. 1996;22(2):168-71. [Google Scholar] [Crossref]