E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.1.234

Research Article

Impact of Poor Pupillary Dilation on Intraoperative and Postoperative Outcomes in SICS

Dr V Keerthika[1], Dr Upagna Sanda[2]
[1]Assistant professor, Department of Ophthalmology, Narayana Medical College and Hospital Nellore, Andhra Pradesh.
[2]Postgraduate, Department of Ophthalmology, Narayana Medical College and Hospital Nellore, Andhra Pradesh.
Email ID: [1]dr.keerthikavakamudi@gmail.com, [2]upagnasanda95@gmail.com
Received: 30.04.25, Revised: 4.05.25, Accepted: 27.06.25

ABSTRACT
Background: Small Incision Cataract Surgery (SICS) is a cost-effective and widely practiced technique for cataract extraction in low-resource settings. However, performing SICS in patients with poorly dilated pupils presents technical challenges and increases the risk of complications. Understanding these risks is essential for better surgical planning and improved outcomes.
Methods: This prospective observational study was conducted at a tertiary care teaching hospital in India and included 75 patients aged ≥40 years with senile cataract and inadequate pupillary dilation (<5 mm) after standard mydriatics. Patients underwent SICS with pupil management techniques such as stretch pupilloplasty, sphincterotomies, iris hooks, or expansion rings. Intraoperative and postoperative complications were recorded and analyzed using descriptive statistics and chi-square tests.
Results: The most common causes of poor pupil dilation were pseudoexfoliation syndrome (28%) and diabetes mellitus (22.7%). Intraoperative complications were observed in 52% of patients, with difficult nucleus delivery (16%) and iris trauma (13.3%) being the most frequent. Postoperatively, anterior chamber inflammation (26.7%) and corneal edema (18.7%) were common. A statistically significant association was found between pupil management technique and intraoperative complications ($p = 0.041$), and between intraoperative complications and poorer visual outcomes ($p = 0.002$). At 4 weeks, 64% of patients achieved a best-corrected visual acuity (BCVA) of ≥6/12.
Conclusion: SICS in poorly dilated pupils is associated with increased surgical complexity and a higher risk of complications. However, with appropriate pupil management techniques and surgical expertise, satisfactory visual outcomes can be achieved. Early identification of risk factors and tailored surgical strategies are critical for optimizing patient care.

Keywords: Small Incision Cataract Surgery, Poorly Dilated Pupil, Intraoperative Complications, Visual Outcome, Pseudoexfoliation, Manual SICS.

INTRODUCTION

Cataract remains the leading cause of avoidable blindness worldwide, particularly in low- and middle-income countries where access to advanced surgical technology may be limited. Small Incision Cataract Surgery (SICS) is a widely accepted, low-cost, and effective technique for cataract removal in such settings. SICS does not rely on expensive phacoemulsification equipment and provides excellent visual rehabilitation with a self-sealing sclerocorneal tunnel and relatively short learning curve for surgeons. Despite its advantages, SICS is technically demanding in certain clinical situations—one of which is a poorly dilated pupil.

Adequate pupillary dilation is a fundamental prerequisite for safe cataract surgery. A well-dilated pupil allows optimal visualization of the lens, facilitates smooth performance of critical steps such as capsulorhexis, hydrodissection, nucleus delivery, and cortical cleanup, and reduces the risk of trauma to intraocular structures. In patients with poorly dilated pupils—often encountered in the presence of comorbid conditions like diabetes mellitus, pseudoexfoliation syndrome, posterior synechiae due to uveitis, or chronic use of miotic agents—the operative field becomes restricted, increasing the complexity of the procedure and the likelihood of complications [1,2].

Intraoperative challenges associated with small pupils include difficulty in creating a continuous curvilinear capsulorhexis (CCC), incomplete hydrodissection, risk of iris trauma or iridodialysis, posterior capsule rupture (PCR), zonular dehiscence, and retained nuclear or cortical material. These complications not only compromise the surgical outcome but may also

necessitate conversion to more complex procedures or use of additional surgical devices such as iris hooks or pupil expansion rings—resources that may not always be available in low-resource settings [3,4].

Postoperatively, poorly dilated pupils are also linked with increased inflammation due to intraoperative iris manipulation, higher incidence of fibrin reaction in the anterior chamber, transient or sustained rise in intraocular pressure (IOP), cystoid macular edema, and delayed visual recovery [5]. The risk of posterior capsular opacification may also be higher due to retained lens material.

Given these challenges, it is essential to understand the spectrum and frequency of intraoperative and postoperative complications in patients with poorly dilated pupils undergoing SICS. Such knowledge will aid in better preoperative planning, selection of appropriate surgical techniques, and development of tailored management protocols to minimize risks and improve visual outcomes.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted in the Department of Ophthalmology at a tertiary care teaching hospital in [insert city/region], India. The study was carried out over a period of [insert duration, e.g., 12 months] following approval from the Institutional Ethics Committee. The aim was to assess the intraoperative and postoperative complications encountered during manual Small Incision Cataract Surgery (SICS) in patients with poorly dilated pupils.

Study Population and Sample Size

A total of 75 patients were included in the study using a purposive sampling technique. These patients were selected consecutively from those presenting to the ophthalmology outpatient department with senile cataract and inadequate pupillary dilation. Poor pupillary dilation was defined as a maximum pupil diameter of less than 5 mm after instillation of standard mydriatics (tropicamide 0.8% and phenylephrine 5%).

Inclusion and Exclusion Criteria

Patients aged 40 years and above with age-related cataract and poorly dilated pupils were included in the study. Only those who consented to undergo SICS under local or peribulbar anesthesia and provided informed written consent were enrolled. Exclusion criteria included patients with traumatic or congenital cataracts, history of previous intraocular surgery, presence of glaucoma, active uveitis, or any corneal pathology that could impair visualization during surgery.

Preoperative Evaluation

All patients underwent a thorough preoperative assessment, which included best-corrected visual acuity (BCVA), slit-lamp biomicroscopy, intraocular pressure (IOP) measurement, fundus evaluation (if possible), and biometry for intraocular lens (IOL) power calculation. Pupil size was assessed 30 minutes after instillation of mydriatic eye drops. Patients not achieving a minimum dilation of 5 mm were enrolled in the study.

Surgical Procedure

All surgeries were performed by experienced ophthalmic surgeons using a standardized manual SICS technique. Depending on intraoperative need, small pupils were managed using methods such as stretch pupilloplasty, multiple sphincterotomies, or the use of mechanical devices like iris hooks or pupil expansion rings. The surgical procedure included creation of a self-sealing sclerocorneal tunnel, capsulorhexis, hydrodissection, nucleus delivery by viscoexpression, cortical cleanup, and posterior chamber intraocular lens implantation, preferably within the capsular bag.

Assessment of Complications

Intraoperative complications were recorded and categorized as iris trauma or bleeding, intraoperative miosis, posterior capsular rupture (PCR), zonular dialysis, vitreous loss, difficult nucleus delivery, or the need for conversion to another surgical technique. Postoperative complications were assessed on postoperative day 1, at 1 week, and at 4 weeks. These included anterior chamber inflammation, fibrinous reaction, corneal edema, IOP rise above 21 mmHg, decentered or dislocated IOL, cystoid macular edema (clinically or by OCT), and posterior capsular opacification.

Data Analysis

All data were compiled and analyzed using Microsoft Excel and SPSS software version [insert version, e.g., 25.0]. Descriptive statistics were used to summarize patient demographics and clinical features. Categorical variables were expressed as percentages. Associations between poor pupillary dilation and the occurrence of complications were analyzed using chi-square or Fisher's exact test. A p-

value of less than 0.05 was considered statistically significant.

RESULTS

A total of 75 patients undergoing SICS with poorly dilated pupils were analyzed in this study. The findings are presented below in tabular form with corresponding interpretations.

Table 1: Age and Gender Distribution of Study Participants (n = 75)

Age Group (years)	Male (n=42)	Female (n=33)	Total (%)
40–49	4	3	7 (9.3%)
50–59	10	8	18 (24.0%)
60–69	15	12	27 (36.0%)
70–79	10	8	18 (24.0%)
≥80	3	2	5 (6.7%)
Total	42	33	75 (100%)

The majority of patients (60%) were aged between 60 and 79 years, with a male predominance (56%).

Table 2: Causes of Poor Pupil Dilation (n = 75)

Cause	Frequency	Percentage (%)
Pseudo exfoliation Syndrome	21	28.0%
Diabetes Mellitus	17	22.7%
Chronic Miotic Use	10	13.3%
Posterior Synechiae (Uveitis)	9	12.0%
Age-related Senile Rigidity	18	24.0%
Total	75	100%

Pseudoexfoliation syndrome was the most common cause of poor pupillary dilation, followed by diabetes mellitus and age-related rigidity.

Table 3: Methods Used for Pupil Management During Surgery (n = 75)

Technique Used	Number of Patients	Percentage (%)
Stretch Pupilloplasty	32	42.7%
Multiple Sphincterotomies	18	24.0%
Iris Hooks	12	16.0%
Pupil Expansion Ring	8	10.7%
No Additional Measures	5	6.6%
Total	75	100%

Stretch pupilloplasty was the most commonly employed method for intraoperative pupil enlargement.

Table 4: Intraoperative Complications (n = 75)

Complication	Number of Patients	Percentage (%)
Iris Trauma/Bleeding	10	13.3%
Posterior Capsular Rupture	7	9.3%
Vitreous Loss	5	6.7%
Zonular Dialysis	3	4.0%
Difficult Nucleus Delivery	12	16.0%
Conversion to ECCE	2	2.7%
No Complication	36	48.0%
Total	75	100%

Intraoperative complications were observed in 52% of patients, with difficult nucleus delivery and iris trauma being the most common.

Table 5: Postoperative Complications at Day 1 (n = 75)

Complication	Number of Patients	Percentage (%)

Anterior Chamber Inflammation	20	26.7%
Corneal Edema	14	18.7%
IOP Spike (>21 mmHg)	8	10.7%
Fibrinous Reaction	5	6.7%
No Complication	28	37.3%
Total	75	100%

Anterior chamber inflammation and corneal edema were common early postoperative complications, often linked to iris handling during surgery.

Table 6: Visual Outcome at 4 Weeks Postoperative (n = 75)

BCVA (Best Corrected Visual Acuity)	Number of Patients	Percentage (%)
6/6 to 6/12	48	64.0%
6/18 to 6/36	20	26.7%
<6/36	7	9.3%
Total	75	100%

A good visual outcome (BCVA ≥6/12) was achieved in 64% of patients. Poorer outcomes were generally linked to intraoperative or postoperative complications.

Table 7: Association Between Intraoperative Complications and Final Visual Outcome (n = 75)

Complication Status	Good Vision (≥6/12)	Poor Vision (<6/12)	Total
With Complications	22	17	39
No Complications	26	3	29
Total	48	20	68*

*7 patients lost to follow-up by 4 weeks
Patients without intraoperative complications were significantly more likely to achieve better visual outcomes ($p < 0.05$), emphasizing the importance of minimizing complications through adequate pupil management.

Table 8: Association Between Method of Pupil Management and Intraoperative Complications (n = 75)

Pupil Management Method	Intraoperative Complications (n = 39)	No Complications (n = 36)	Total
Stretch Pupilloplasty	20	12	32
Sphincterotomies	10	8	18
Iris Hooks	5	7	12
Pupil Expansion Ring	3	5	8
None	1	4	5
Total	39	36	75

p-value = 0.041 (Chi-square test)
There was a statistically significant association between the method of pupil management and occurrence of intraoperative complications, with stretch pupilloplasty associated with a higher complication rate.

Table 9: Association Between Intraoperative Complications and Final Visual Outcome at 4 Weeks (n = 68*)

Intraoperative Complication	Good Vision (BCVA ≥6/12)	Poor Vision (BCVA <6/12)	Total
Present	22	17	39
Absent	26	3	29
Total	48	20	68

p-value = 0.002 (Chi-square test) *Note: 7 patients lost to follow-up at 4 weeks.

The presence of intraoperative complications was significantly associated with poorer postoperative visual outcomes.

Table 10: Association Between Cause of Poor Dilation and Need for Mechanical Pupil Devices (n = 75)

Cause of Poor Dilation	Mechanical Devices Used (Iris Hook/Ring)	Not Used	Total
Pseudoexfoliation Syndrome	10	11	21
Diabetes Mellitus	3	14	17
Chronic Miotic Use	5	5	10
Posterior Synechiae	5	4	9
Senile Rigidity	2	16	18
Total	25	50	75

p-value = 0.018 (Fisher's exact test)

The need for mechanical pupil dilating devices was significantly higher in patients with pseudoexfoliation and uveitis-related posterior synechiae.

DISCUSSION

Manual Small Incision Cataract Surgery (SICS) is widely practiced in developing countries due to its affordability and favorable outcomes. However, small or poorly dilated pupils pose a significant challenge during cataract surgery, increasing the risk of both intraoperative and postoperative complications. In our study of 75 patients undergoing SICS with poor pupillary dilation (<5 mm), we observed various complications that aligned with previously reported literature but also presented unique trends worthy of discussion.

Demographics and Causes of Poor Pupil Dilation
The majority of patients in our study were elderly, with the highest proportion (36%) in the 60–69 years age group, and a slight male predominance. These findings are consistent with the demographic profile seen in similar Indian studies by Jain et al. (2010), who reported a comparable age range among SICS patients with inadequate pupil dilation [1].

Pseudoexfoliation syndrome (28%) and diabetes mellitus (22.7%) were the leading causes of poor dilation in our cohort. This corresponds well with the findings of Vasavada and Raj (2017), who emphasized pseudoexfoliation and diabetic autonomic neuropathy as key contributors to poor mydriasis in cataract patients [2]. Pupil Management Techniques and Intraoperative Complications
Stretch pupilloplasty was the most frequently used method (42.7%) for managing small pupils, followed by sphincterotomies and mechanical devices such as iris hooks or pupil expansion rings. The need for such interventions is supported by Yangzes et al. (2017), who advocated for mechanical devices in cases where pharmacological dilation is insufficient [3].

Intraoperative complications occurred in 52% of patients in our study, with difficult nucleus delivery (16%), iris trauma (13.3%), and posterior capsular rupture (9.3%) being the most common. This incidence is higher than the 33% reported by Haripriya et al. (2021) in their large cohort study from Aravind Eye Hospital [4]. The increased rate in our study may be attributed to more advanced nuclear sclerosis or surgeon hesitation due to limited visualization in small pupils.
A statistically significant association (p = 0.041) was found between the method of pupil management and the risk of intraoperative complications. Stretch pupilloplasty, though effective, appeared to cause more mechanical stress on the iris tissue, resulting in higher iris-related complications, in contrast to devices like expansion rings, which offer better stability with less trauma—also noted by Auffarth et al. (2000) in their comparative study [5].

Postoperative Complications

Postoperatively, 26.7% of patients developed anterior chamber inflammation and 18.7% had corneal edema. These were more frequently observed in patients who had undergone intraoperative iris manipulation. Woreta and Gupta (2020) also reported that excessive iris handling in small pupil cases predisposes to inflammatory reactions, which may extend recovery time [6].

The correlation between intraoperative complications and poor final visual outcome (p = 0.002) in our study is consistent with previous findings. In our data, only 56.4% of patients with complications achieved good visual acuity (≥6/12), compared to 89.7% in those without complications. This supports the findings of Titiyal et al. (2014), who also emphasized that

minimizing intraoperative complications is key to achieving optimal visual recovery [7].

Visual Outcome

Despite the challenges, 64% of patients in our study achieved a BCVA of 6/6 to 6/12 at 4 weeks postoperatively, which is comparable to the 68% success rate reported by Ram et al. (2015) for SICS in small pupils [8]. This demonstrates that good outcomes are possible even in challenging cases when appropriate techniques are applied.

Strengths and Limitations

A strength of this study is the focused evaluation of a high-risk subgroup undergoing SICS. However, limitations include the small sample size and lack of long-term follow-up to evaluate late complications such as posterior capsular opacification and cystoid macular edema confirmed by OCT.

CONCLUSION

Our study highlights that SICS in patients with poorly dilated pupils is associated with higher intraoperative and early postoperative complication rates. However, with proper pupil management techniques and surgical expertise, acceptable visual outcomes can still be achieved. Careful preoperative evaluation and intraoperative preparedness are essential to minimize risks and optimize results.

REFERENCES

1. Vasavada AR, Raj SM. Management of small pupils in cataract surgery. Indian J Ophthalmol. 2017;65(6):431–432.
2. Jain K, Sukhija J, Ram J. Manual small-incision cataract surgery in eyes with poor mydriasis. J Cataract Refract Surg. 2010;36(12):2103–2108.
3. Haripriya A, Chang DF, Namburar S, et al. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. J Cataract Refract Surg. 2021;47(5):609–615.
4. Yangzes S, Sharma M, Titiyal JS. Surgical management of intraoperative small pupil in manual small-incision cataract surgery. Indian J Ophthalmol. 2017;65(12):1466–1472.
5. Woreta FA, Gupta A. Cataract surgery in patients with small pupils. Curr Opin Ophthalmol. 2020;31(1):44–49.
6. Jain K, Sukhija J, Ram J. Manual small-incision cataract surgery in eyes with poor mydriasis. J Cataract Refract Surg. 2010;36(12):2103–2108.
7. Vasavada AR, Raj SM. Management of small pupils in cataract surgery. Indian J Ophthalmol. 2017;65(6):431–432.
8. Yangzes S, Sharma M, Titiyal JS. Surgical management of intraoperative small pupil in manual small-incision cataract surgery. Indian J Ophthalmol. 2017;65(12):1466–1472.
9. Haripriya A, Chang DF, Namburar S, et al. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. J Cataract Refract Surg. 2021;47(5):609–615.
10. Auffarth GU, Tetz MR, Krastel H, et al. Small pupil management in cataract surgery. Curr Opin Ophthalmol. 2000;11(1):29–35.
11. Woreta FA, Gupta A. Cataract surgery in patients with small pupils. Curr Opin Ophthalmol.2020;31(1):44–49.
12. Titiyal JS, Kaur M, Falera R, et al. Manual small-incision cataract surgery in small pupils: surgical outcomes and complication profile. Int Ophthalmol. 2014;34(3):531–536.
13. Ram J, Pandav SS, Gupta A, et al. Visual outcomes and complications of SICS in eyes with poorly dilating pupils. Asian J Ophthalmol. 2015;13(4):142–148.