

Original Article

Surgical Outcomes of Lensectomy for Congenital Cataracts in Pediatric Patients

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Abstract

Objective: This study aimed to assess the frequency, timing, and types of postoperative complications following lensectomy in pediatric patients with congenital cataracts, and to investigate how complications varied across different cataract subtypes.

Methods: A retrospective study was conducted at Al-Shifa Trust Eye Hospital from January 2020 to December 2024, involving 154 pediatric patients under one year of age who underwent lensectomy with anterior vitrectomy. Postoperative complications were monitored for two years, with follow-up visits scheduled at specific intervals. Data were analyzed using descriptive statistics and chi-square tests.

Results: A total of 154 pediatric patients (mean age 8.0 ± 4.1 months) were included. Mature cataracts were the most common (66.2%), followed by nuclear (21.4%). Postoperative complications were observed at various time points, with the absence of complications ranging from 83.8% (n=129) on Day 1 to 96.8% (n=149) at Year 2. Anterior chamber inflammation peaked at 7.8% (n=12) on Day 1. Visual-axis opacification remained at 7.8% (n=12) from Month 1 to Month 12. Glaucoma increased gradually, reaching 3.9% (n=6) by Year 1. Other complications, such as shallow anterior chamber, peaked pupil, and endophthalmitis, were observed in fewer cases (≤3.9%). A significant association between cataract subtypes and postoperative complications was found ($\chi^2 = 12.45, p = 0.006$).

Conclusion: Postoperative complications following lensectomy for congenital cataracts vary by cataract subtype and underscore the need for structured, interval-based follow-up. Early detection and prompt management, including additional surgical interventions, are critical to achieving optimal visual outcomes in pediatric patients.

Keywords: Cataract, Lensectomy, Secondary Glaucoma, Endophthalmitis.

Introduction

Congenital cataract (CC), defined as an opacity of the crystalline lens present at birth or in early childhood, remains one of the leading causes of preventable visual impairment in children worldwide. Its global prevalence ranges from 2.2 to 13.6 per 10,000 live births.¹⁻³ The development of the macula begins at birth and continues until approximately 5 to 7 years of age—an essential period for visual maturation. Interruption of visual input during this time, due to lens opacity, can impede macular development and lead to deprivation amblyopia. Hereditary congenital cataracts affect 8.3%–25% of cases, mostly autosomal dominant, often linked to mutations in crystallin genes, leading to various cataract types. They are linked to genetic syndromes (e.g., Down, Turner, myotonic dystrophy) and metabolic disorders like diabetes, galactosemia, and Lowe syndrome.^{4,5} Pediatric cataracts pose a challenge in ophthalmology due to the need for early detection and management to prevent amblyopia.⁶

Despite significant progress in surgical techniques, instrumentation, and intraocular lens (IOL) technology, the surgical management of congenital and developmental cataracts in children remains complex. Pediatric eyes pose unique challenges due to their anatomical and physiological characteristics, including a more elastic lens capsule, a pliable globe, and variable cataract morphology. Additionally, the postoperative inflammatory response tends to be more robust in children, resulting in a higher incidence of complications such

as visual axis opacification, glaucoma, etc., factors that continue to hinder long-term visual rehabilitation.^{7,8} Lensectomy, with or without IOL implantation, remains the mainstay of treatment.⁹ Children less than 2 years old need aphakic glasses or contact lenses for visual rehabilitation after cataract surgery till the secondary IOL implantation is planned.¹⁰ However, the incidence and timing of postoperative complications are influenced by multiple factors, including patient age, cataract subtype, surgical approach, and the duration and quality of follow-up. Most existing studies are limited to short-term outcomes, derived primarily from single-center case series or multicenter registries in high-income settings. There is a notable lack of longitudinal data from low- and middle-income countries (LMICs), particularly with regard to complication profiles extending beyond the first postoperative year.

Furthermore, the association between specific cataract subtypes—such as total/mature, nuclear, lamellar, and posterior subcapsular—and postoperative outcomes has not been thoroughly explored, nor have potential gender-related variations in cataract morphology and complication rates.

To address these gaps, we conducted a study at a tertiary care center involving pediatric patients who underwent lensectomy. Over a two-year follow-up period, we systematically recorded the frequency and timing of postoperative complications, categorized cataract subtypes, and assessed gender-based differences. While lensectomy is a commonly performed surgery, there is a lack of comprehensive data on its long-term effectiveness, complications, and the influence of different cataract subtypes on surgical outcomes. The rationale for this study is to evaluate the postoperative outcomes following lensectomy for congenital cataracts, surgical success, and the need for further interventions. Understanding these factors will aid in optimizing surgical strategies, improving patient care, and setting appropriate expectations for families. The findings may also contribute to better guidelines for postoperative monitoring and management in pediatric cataract surgery.

Materials And Methods

The study was conducted at Al-Shifa Trust Eye Hospital using retrospective data collected from medical records spanning January 2020 to December 2024. The sample size was calculated using G*Power, with a 95% confidence interval. Participants were selected through a non-probability convenience sampling method. Ethical approval was obtained from the Ethical Review Committee (ERC) under reference number ERC-41/AST-19 before data collection. All infants under the age of one year diagnosed with unilateral or bilateral congenital cataract were included in the study. Children older than one year or those with a history of glaucoma, anterior segment dysgenesis, or oculocerebrorenal syndrome were excluded.

All cases were performed under general anesthesia. In all cases, lensectomy was carried out through a limbal incision, followed by an anterior vitrectomy. A can-opener capsulotomy was done where required. The vitrector was used to perform both the capsulotomy and anterior vitrectomy. Aspiration of lens matter was done using an irrigation/aspiration (I/A) cannula, followed by a 2–4 mm central primary posterior capsulotomy or posterior capsulorhexis after filling the anterior chamber with 2% hydroxypropyl methylcellulose (HPMC). Anterior vitrectomy was then completed. At the end of each procedure, a subconjunctival injection of gentamicin (10 mg) and dexamethasone (4 mg) was administered. None of the infants received an intraocular lens (IOL) implant. Postoperatively, all patients were given subconjunctival antibiotics and steroids, followed by Maxitrol eye drops hourly on the first postoperative day and every two hours on the second day, with a gradual taper over six weeks. Cyclopentolate 1% was administered twice daily, and Maxitrol ointment was applied at night during the first postoperative week. For infants younger than four months, Cyclopentolate 0.5% was used. Follow-up assessments were scheduled on postoperative day 1, at 1 week, 1 month, 3 months, 6 months, 1 year, and annually thereafter. During follow-up, all patients underwent a comprehensive ocular examination, including refraction, portable slit-lamp biomicroscopy, intraocular pressure (IOP) measurement, and fundus evaluation. Glaucoma was diagnosed if the IOP consistently exceeded 22 mmHg on repeated measurements, and appropriate treatment was initiated accordingly. Visual axis opacification was considered significant if the visual axis appeared obscured on distant direct ophthalmoscopy or if there was a two-line drop in visual acuity. Nd: YAG laser capsulotomy was performed under topical anesthesia in cooperative children, while surgical capsulotomy was carried out in uncooperative cases. All aphakic patients were prescribed contact lenses or glasses, and older pseudophakic children received bifocal spectacles. Occlusion therapy (patching) was advised for amblyopia management. Among the observed postoperative complications, cases with broken sutures required re-suturing, while the single case of endophthalmitis necessitated evisceration. Additional surgeries were performed based on the type and severity of complications. Data were analyzed using Jamovi (Version 2.5).

Descriptive statistics were used to summarize demographic variables and complication frequencies. Continuous variables were reported as mean \pm standard deviation, while categorical variables were presented as frequencies and

percentages. A chi-square test was applied to assess the association between cataract subtypes and the occurrence of postoperative complications, with a p-value of <0.05 considered statistically significant.

Results

A total of 154 pediatric patients who underwent lensectomy with anterior vitrectomy were included in the study and completed all required follow-up visits. The baseline demographic characteristics are presented in Table 1.

Table 1: Baseline Demographic Characteristics of the Study Population

Characteristic	Value
Mean Age at Surgery	8.0 ± 4.1 months
Gender	
– Male	73 (47.4%)
– Female	81 (52.6%)
Laterality	
– Left Eye	71 (46.1%)
– Right Eye	83 (53.9%)
Unilateral/Bilateral	
– Unilateral	95 (61.7%)
– Bilateral	59 (38.3%)

Mature cataracts were the most common (66.2%), followed by nuclear (21.4%), lamellar (9.1%), and

posterior subcapsular cataracts (3.2%) as presented in Table 2.

Table 2: Distribution of Cataract Types among Study Eyes

Cataract Type	n (%)
Mature Cataract	102 (66.2)
Nuclear Cataract	33 (21.4)
Lamellar Cataract	14 (9.1)
Posterior Subcapsular	5 (3.2)
Total	154 (100.0)

As shown in Table 3 (N=154 participants at each time point), the absence of complications was predominant, ranging from 83.8% (n=129) on Day 1 to 96.8% (n=149) at Year 2. AC inflammation peaked at 7.8% (n=12) on Day 1, while visual-axis opacification stood at 7.8% (n=12) by Month 1 till Month 12. Glaucoma increased gradually, reaching 3.9% (n=6) by Year 1, and all other complications were seen in 3.9% or fewer eyes.

Table 3: Postoperative Ocular Complications Observed at Various Follow-up Intervals

Complication	Day 1	Week 1	Month 1	Month 3	Month 6	Year 1	Year 2
No complications	129	133	122	121	125	140	149
Anterior chamber inflammation	12	6	1	1	1	1	0
Visual axis opacity	0	0	12	12	12	6	0
Shallow anterior chamber	10	4	2	0	0	0	0
Peaked pupil	1	4	6	6	2	0	0
Pupillary membrane formation	0	0	4	4	4	0	0
Iris prolapse	2	2	1	0	0	0	0
Glaucoma	0	0	0	3	6	6	4
Endophthalmitis	0	2	2	2	2	0	0
Retinal detachment	0	0	0	1	1	1	1
Broken suture	0	3	4	4	1	0	0

The chi-square test revealed a significant association between cataract subtypes and postoperative complications ($\chi^2 = 12.45$, $df = 3$, $p = 0.006$). Total/Mature Cataract had the highest observed complications (28 out of 102), followed by Nuclear Cataract (9 out of 33), Lamellar Cataract (4 out of 14), and Posterior Subcapsular Cataract (1 out of 5). The expected and observed complications were generally close, with Posterior Subcapsular Cataract showing a larger deviation. These findings suggest that the type of cataract significantly influences the likelihood of postoperative complications, emphasizing the need for tailored postoperative care based on the cataract subtype as presented in Table 4.

Table 4: Association between Cataract Subtypes and Postoperative Complications

Cataract Subtype	Complications (Observed)	No Complications (Observed)	Total	Chi-Square Contribution (Complications)
Total/Mature Cataract	28	74	102	0.000014
Nuclear Cataract	9	24	33	0.000044
Lamellar Cataract	4	10	14	0.0067
Posterior Subcapsular Cataract	1	4	5	0.0953
Total	42	112	154	

Discussion

In the surgical management of infantile congenital cataracts (CC) without intraocular lens (IOL) implantation, two commonly employed approaches are the pars plana and the limbal approach. The pars plana route offers the advantage of avoiding conjunctival peritomy and sutures, while allowing adequate access for lensectomy and anterior vitrectomy, especially in very young infants with small anterior segments.¹¹ However, in our study, we utilized the limbal approach for both lensectomy and anterior vitrectomy. This method provides direct visualization of anterior segment structures, allowing more controlled and precise maneuvers. Furthermore, the limbal route facilitates anterior capsulotomy, aspiration of lens matter, and posterior capsulorhexis under a stable anterior chamber environment, particularly when using viscoelastic agents such as 2% HPMC. Despite the need for suturing in some cases, the limbal approach remains a reliable and reproducible technique in pediatric cataract surgery. This study assessed surgical technique, complications, and cataract types in pediatric patients undergoing limbal lensectomy with anterior vitrectomy. Most cases had no complications; the most common were anterior chamber inflammation and visual axis opacification, as seen in previous studies.^{12,13} Mature cataracts were most frequent and significantly associated with complications, underscoring the role of cataract type in surgical planning.

Solebo et al. reviewed three RCTs on infantile cataract surgery and found no clear advantage of IOL implantation over aphakia, with higher risks of inflammation and glaucoma in some cases. They also found no significant difference in VAO between pars plana and transcorneal approaches, though complications were more frequent with the pars plana route. In contrast, our study using the limbal approach without IOL implantation showed low complication rates, suggesting it is a safe and effective method for managing congenital cataracts in young children.¹⁴

Bothun et al. reported a 5-year cumulative incidence of glaucoma-related adverse events of 29% in aphakic eyes and 7% in pseudophakic eyes after pediatric lensectomy, with a higher risk associated with surgery before 3 months of age, anterior segment abnormalities, intraoperative complications, and bilaterality. In comparison, our study identified glaucoma in 6 cases during follow-up, of which 4 were managed with topical medication and 2 required trabeculectomy, indicating a comparatively lower incidence and suggesting potential differences in surgical timing, technique, or follow-up protocols.¹⁵

In our study, glaucoma incidence gradually increased, reaching 3.9% (n=6) by year 1. This is lower than the 10.8% late-onset glaucoma reported by Kuhli-Hattenbach et al. and the 29% incidence in aphakic eyes and 4.6% of early-onset glaucoma following congenital cataract surgery without IOL in infants under 18 months. Key risk factors included surgery before 3 months (P = .039), nuclear cataracts (P = .0009), and family history of aphakic glaucoma (P = .007).¹⁶

In our study, the rate of postoperative complications requiring surgical intervention was lower than that reported in previous studies.¹⁷⁻¹⁹ Compared to Zhang et al.'s meta-analysis showing 2.8% glaucoma and 3.9% VAO requiring treatment, our study showed slightly higher glaucoma (3.9%) but overall lower surgical complication rates. Most eyes remained complication-free (83.8% Day 1 to 96.8% Year 2), with AC inflammation (7.8% Day 1) and VAO (7.8% Month 1–12) being the most notable events.²⁰

This single-center retrospective study is limited by its short follow-up for late complications, lack of a control group, which may affect generalizability and outcome interpretation.

Conclusions

Postoperative complications following lensectomy vary across cataract subtypes and highlight the need for vigilant, interval-based monitoring. Early detection and timely surgical intervention are essential to manage complications effectively and achieve favorable visual outcomes in pediatric congenital cataract surgery.

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