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Original Research Article

Long-Term Visual Outcome and Complications of Congenital and Developmental Cataract Surgery in a Tertiary Care Hospital in Eastern India: A Prospective Observational Study

Fariduddin K.[1], Mallick S.[2], Lynapawngia S.[3]

[1]Associate Professor, Regional Institute of Ophthalmology, Kolkata Medical College, Kolkata, West Bengal, India

[2]Assistant Professor, Regional Institute of Ophthalmology, Kolkata Medical College, Kolkata, West Bengal, India

[3]Junior Resident, Regional Institute of Ophthalmology, Kolkata Medical College, Kolkata, West Bengal, India

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Corresponding author: Dr. Fariduddin K.

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Abstract

Background: Clear vision during childhood is crucial for the proper development of the visual system; therefore, any obstruction like cataracts can result in long-term visual impairment such as strabismus and amblyopia. Hence, for early cataract development (2-3 months) and unilateral cataract, best visual acuity is acquired if a cataract operation is done between 4-6 weeks and amblyopia development is better prevented compared to surgery done at later weeks. For bilateral cataracts, surgery is best carried out at 6 weeks with 1 week apart for both surgeries, this is done to avoid amblyopia.

Materials and Methods: Our study focused on the outcomes of congenital and developmental cataract surgeries at the Regional Institute of Ophthalmology, Kolkata. Patients between 3 months to 12 years old with congenital or developmental cataracts undergoing surgery at the institute were evaluated over a 3-month follow-up period.

Patients were examined post-surgery for early complications, followed by outpatient visits at RIO, Kolkata on specific intervals for up to 3 months, including visual acuity measurement, refraction, and monitoring for complications.

Results: In our study, out of 130 eyes (taking each affected eye as a separate case), 81 (62%) were male and 49 (38%) were female. The mean Visual Acuity (VA) at onset in cataracts who presented at <1 year of age is 1.271 and final post op BCVA (Best corrected visual acuity) was 0.80. The mean VA at onset in cataracts who presented at 1-3 years of age is 1.065 and final post op BCVA was 0.744. The mean VA at onset in cataracts who presented at >3 years of age is 1.000 and final post op BCVA was 0.6776. R value according to Pearson's coefficient is 0.257, 0.520, 0.599 respectively. Hence there is a positive correlation between age of onset of disease and Mean VA at onset as well as final BCVA at 3 months. PCO is the most common complication here and the percentage of the PCO is about 43.75%.

Conclusion: Our study showed a positive correlation between the age of disease onset and age of presentation at hospital and visual acuity outcomes. The later the presentation or delay in seeking medical attention has much impact on the visual outcomes and related complications.

Keywords: Congenital cataract, capsulorrhexis, Intra ocular lens implantation, Posterior capsular opacification, cystoids macular oedema.

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Introduction

Congenital cataract is one of the most common causes of preventable childhood blindness worldwide, accounting for a significant proportion of visual impairment in both developing and developed countries. It occurs either as an isolated ocular condition or in association with systemic or genetic disorders. Early diagnosis and timely surgical intervention are critical for optimal visual development due to the sensitive period of visual maturation in early childhood. While advances in surgical techniques and intraocular lens (IOL) technology have improved short-term outcomes,

the long-term visual prognosis remains variable and is influenced by multiple factors including age at surgery, laterality, surgical technique, postoperative care, and adherence to amblyopia therapy. Furthermore, long-term complications such as posterior capsular opacification (PCO), glaucoma, strabismus, retinal detachment, and secondary membrane formation continue to pose challenges in postoperative management.

Several studies have highlighted the benefits of early surgery, particularly within the first few weeks of life, in minimizing amblyopia and improving final visual acuity. However, the long-term impact of these interventions, especially in resource-constrained settings where follow-up may be inconsistent, is less well understood. Additionally, while the incidence of some complications like PCO is common and well documented, their clinical course and visual implications over time remain areas of ongoing study.

This study aims to evaluate the long-term visual outcomes and postoperative complications in children undergoing congenital cataract surgery, with the goal of identifying prognostic indicators and informing future guidelines for surgical timing, technique, and follow-up protocols.

The proportion of blindness in children due to paediatric cataracts varies globally between 10-30%, with an average of 14%. [3] In India, congenital and developmental cataracts account for over 10-12% of childhood blindness, affecting approximately 3 out of every 10,000 newborns in India Shamanna BR and Muralikrishnan R et al [4] in 2004 reported a global prevalence of childhood cataract-related blindness ranging from 10% to 30%, with a global average of 14% Khokhar et al [5], in their 2017 study, highlighted that childhood cataracts account for about 10 million blind-person-years (14%) out of approximately 70 million blind-person-years due to childhood blindness globally [6]. Saxena et al, [7] in their 2015 research, categorized childhood blindness into preventable and curable causes, with treatable refractive error being the leading cause of blindness (33.3%). Early surgery is recommended for patients with unilateral cataracts and for the second eye of children with bilateral cataracts, especially if one eye has already been operated on, to prevent amblyopia. [8] Timely surgery is also essential for bilateral dense cataracts to avoid stimulus deprivation amblyopia. Posterior capsular opacification (PCO) is a common cause of reduced visual acuity after paediatric cataract surgery. [9] For dense unilateral congenital cataracts, optimal visual acuity is achieved when surgery is done before 6 weeks of age and followed by amblyopia treatment. [10] However, early surgery alone doesn't guarantee a good outcome because postoperative management plays a critical role especially for treating amblyopia.

Surgical procedures were based on the patient's age, the density of the cataract, and the laterality of the cataract. For children under 2 years old, lens aspiration along with primary posterior capsulorhexis (PC optically corrected glass prescription and potential secondary intraocular lens (IOL) implantation for those who were kept aphakic for some unavoidable reason. [11] Older children underwent lens aspiration with a foldable IOL, with or without primary posterior capsulorhexis and limited anterior vitrectomy.

Posterior capsulorhexis is usually carried out in paediatric surgeries of younger patients to prevent the development of posterior capsular opacity because to do Nd: YAG capsulotomy in this age group is difficult as patients will not be cooperative enough with the procedure. Therefore, up to 8 years of age, posterior capsulorhexis with or without vitrectomy is required. [12]

Aims and Objectives: To assess the long-term visual outcomes and complications of surgery for congenital or developmental cataracts at the Regional Institute of Ophthalmology, Kolkata over a period of 3 months.

Material and Methods

The study was conducted at the Regional Institute of Ophthalmology (RIO), Kolkata Medical College, Kolkata (Ref. No: MCK/KOL/IEC/NON-SPON/1627/11/2022 dated 11/11/2022). The participants were recruited from the outpatient department, paediatric ophthalmology clinic, and inpatient facilities at RIO, Kolkata. These individuals hailed from various districts of West Bengal, with one exception from Bihar. Assessments under anaesthesia were carried out in the operation theatre complex of RIO as needed.

Study Population: Participants aged between 3 months and 12 years with congenital or developmental cataracts who underwent cataract extraction surgery at RIO, Kolkata from December 2022 to May 2024 were included in the study. Written consent was obtained from the guardian of each patient to participate in the study.

Inclusion Criteria

1. Individuals aged 3 months-12 years, regardless of gender.
2. Those diagnosed with congenital or developmental cataracts.
3. Patients who underwent cataract extraction surgery at RIO between December 2022 to May 2024.
4. Participants willing to take part in the study.

Exclusion Criteria

1. Patients with a history of ocular trauma.

2. Individuals with any other ocular conditions such as corneal opacity, congenital glaucoma, chronic uveitis, or posterior segment pathology.
3. Patients with eventful procedures intraoperatively.
4. Patients of Aged less than 3 months.
5. Patients who lost follow-up after surgery.

Sample Size: The study included 76 participants, total of 130 eyes (each eye is considered as one case) with congenital or developmental cataracts of bilateral or unilateral 130 cases. The sample size is calculated using the systemic random sampling method,

n =4pq/l2.From the previous literature we find that p=42.2%

Using the mentioned formula we calculate

n= 4 x 42.2 x 57.8 (q=100-p, 20% Error So, l = 20/100 x 42.2 = 8.4),

n= 138. Eligible cases will be around 130 as per inclusion and exclusion criteria and error of loss of follow up.

Study Design: A prospective and observational study.

Study Parameters

During each postoperative visit, the following parameters were recorded:

1. Visual acuity.
2. Refractive status.
3. Presence of any postoperative complications.

Clinical History: A comprehensive history was taken to rule out systemic conditions affecting ocular health. All patients underwent a pre-anaesthetic check-up, which included a thyroid profile, complete blood tests, chest X-ray (PA view), stool examination for ova, parasites, and cysts (OPC), cardiac fitness evaluation, and pediatric clearance. Only after obtaining clearance from the pre-anaesthetic check-up (PAC) were patients taken for surgery.

Ocular examination involved the following steps: Preoperative ocular evaluation was initially conducted using a pen torch to assess the eyelids and ocular adnexa for any abnormalities. Both direct and consensual pupillary light reflexes were observed and documented.

Slit-lamp examination was performed (with and without pupil dilation) for cooperative children older than 2 years. For less cooperative children, a thorough examination was done under general anaesthesia using a microscope and indirect ophthalmoscope.

Intraocular pressure was measured using a non-contact tonometer (NCT) in cooperative, older children prior to surgery.

Preoperative B-scan ultrasonography was conducted to assess the posterior segment of the eye and to determine axial length for intraocular lens (IOL) power calculation in some patients.

Visual acuity and refractive assessment: The refractive status was evaluated using a retinoscope, Snellen's chart, or Teller's visual acuity cards, depending on the patient's level of cooperation. Visual acuity was measured preoperatively and during postoperative follow-up using age-appropriate charts:

- **0–2 years:** Teller Acuity Cards
- **2–5 years:** Lea Symbol Charts
- **5 years and above:** Snellen’s Letter Chart
- **Illiterate children:** Snellen's E Chart or Landolt C's Broken Ring Chart

Operative Procedure: Under general anaesthesia, lens matter was aspirated after performing an anterior capsulorhexis. In patients planned for IOL implantation, foldable intraocular lenses were inserted through a 3 mm clear corneal incision. Children under 2 years of age were left aphakic, with secondary IOL implantation planned after they reached 3 years. In the meantime, aphakic correction was provided using contact lenses or aphakic glasses. Primary posterior capsulorhexis and limited anterior vitrectomy were performed in younger children who were unlikely to cooperate for Nd: YAG laser capsulotomy in the event of posterior capsular opacification (PCO). The surgical wound was closed using 10-0 monofilament nylon sutures.

Postoperative Care: Patients received topical antibiotics, steroids, and mydriatics. Systemic antibiotics and steroids were also administered and tapered gradually. Patients were followed up post-surgery for detection of early complications, visual acuity measurement and refraction at OPD on specific intervals for up to 3 months

Results

Lens aspiration with primary IOL implantation (L+I) was performed in 54.62% cases lens aspiration with posterior capsulorrhexis and vitrectomy (L+P+V) in 12.31% cases, lens aspiration with primary IOL implantation with posterior capsulorhexis with anterior vitrectomy (L+I+P++V) in 31.54% cases and lens aspiration with primary IOL implantation with posterior capsulorhexis without vitrectomy (L+I+P) in 1.54% cases. Out of these Primary IOL with only lens aspiration was performed in 86% of lamellar cataracts and 29.16% of nuclear cataracts. Primary IOL could not be implanted in a total of 12.30% of

cases of which 68.75 % cases were of nuclear cataracts. Anterior vitrectomy had to be performed in a total of 43.84% cases of which 47.36% cases had nuclear cataracts.

Table 1: Treatment modalities of various types of congenital cataract:

Types of surgeries	Lamellar cataract	Nuclear cataract	Total Cataract	Sutural cataract	Posterior Polar	Total No.of patients
L+I	43	14	10	4	0	71
L+P+V	2	11	3	0	0	16
L+I+P+V	14	16	7	2	2	41
L+I+P	0	2	0	0	0	2
Total	59	43	20	6	2	130

The mean VA at onset in cataracts who presented at <1 year of age is 1.271 and final post-operative BCVA was 0.80. The mean VA at onset in cataracts who presented at 1-3 years of age is 1.065 and final post op BCVA was 0.744. The mean VA at onset in cataracts who presented at >3 years of age is 1.000 and final post op BCVA was 0.6776. R value according to Pearson's coefficient is 0.257, 0.520, 0.599 respectively. Hence there is a positive correlation between age of onset of disease (Table no 2) and mean VA at onset as well as final BCVA at 3 months follow up period.

Table 2: Co-Relation between Age at Onset and Post-Operative BCVA

Age	Mean Age	Mean VA at onset	Mean BCVA at 3 months
< 1 yr	0.464yrs	1.271	0.8
1 – 3 yrs	2.02yrs	1.065	0.744
>3yrs	6.618yrs	1.000	0.6776

The mean delay in surgery (Table no 3) from presentation in patients less than 1 year of age is 1.45 years with a final post op BCVA of 0.7 The mean delay in surgery from presentation in patients 1-3 years of age is 1.787 years with a final post op BCVA of 0.695.The mean delay in surgery from presentation in patients >3years of age is 1.857 years with a final post op BCVA of 0.677. R value according to Pearson's coefficient is 0.000. Hence it is seen that delay in surgery has no significant role in the Final outcome when it is less than 1 year from age of onset according to our study.

Table 3: Correlation between Mean delay in surgery and VA at onset as well as BCVA at 3 months

Age at onset	Mean delay in Surgery (in years)	VA at onset	BCVA at 3 months
<1yr	1.45	1.144	0.764
1–3yrs	1.787	0.959	0.693
>3yrs	1.857	1.032	0.677

Post-operative complications (Table no 4) were noted in different surgical procedures as follows:

In L+I category, PCO occurred in 7cases, CME occurred in 2 cases, Optic Catch occurred in 3 cases, and no complications was noted in 61cases.In L+I+P+V category, PCO noted in 3 cases, CME and Optic Catch occurred 0 case, and None occurred 38 cases. In L+P+V category, PCO was noted in 1 case, CME occurred 0 case, Optic Catch was noted 1 case, and none occurred 14 cases. In the L+I+P category, PCO occurred 1 case, CME occurred 0 case, Optic Catch occurred 0 case, and none occurred 1case.

Table 4: Post-operative Complications at 3 months

	PCO	CME	Optic Catch	None
L+I	7	2	3	61
L+I+P+V	3	0	0	38
L+P+V	1	0	1	14
L+I+P	1	0	0	1

PCO is the most common complication here. The percentage of the PCO is about 43.75%

Discussion

In our study, there was a statistical difference in male and female who were presented at RIO, OPD, and Kolkata. Male patients outnumbered female patients and received medical attention from their families at a younger age. In our study, out of 130 eyes (taking each affected eye as a separate case), 81 (62%) were male and 49 (38%) were female. In our study, we found the mean VA at onset in

cataracts presenting <1 year of age was 1.271, and the final post-op BCVA was 0.80; for 1-3 years, it was 1.065 and 0.744, respectively. A positive correlation existed between age of onset and mean VA at onset as well as final BCVA at 3 months. Thus, BCVA is not influenced by cataract laterality if early intervention is provided. Regardless of laterality, likely due to late presentation, the most common BCVA remains >1 logMAR.

Lambert, S.R., Lynn, M.J., Hartmann [13] conducted a prospective multicenter trial on cataract surgery outcomes in infants <6 months old. Ninety-two infants with bilateral congenital cataracts had one eye operated on at 4-16 weeks, with the second eye treated within 6 weeks. Postoperative visual acuity was assessed using preferential looking and Snellen optotypes. At a mean follow-up of 7.7 years, 63% (58/92) achieved BCVA of 20/40 or better, 32% (29/92) achieved 20/20 or better, and only 5% (5/92) developed amblyopia. The findings highlight that early cataract surgery significantly improves visual outcomes and reduces amblyopia risk compared to later interventions.

Posterior capsular opacification was found in all 7 cases who did not undergo anterior vitrectomy and posterior capsulorrhexis in our study. Thus, pediatric cataract surgery generally corresponds with postoperative capsular epithelial outgrowth, possibly linked to surgical technique or the uveal/capsular biocompatibility of the IOL used. It is good practice to perform primary posterior capsulorrhexis and limited anterior vitrectomy, especially in younger children up to 8 years and mentally challenged patients, to reduce early onset of PCO. This is corresponding to the finding of Narain, S., Ali, M. M., & Foster et al [14] study. Found that Posterior capsule opacification (PCO) is a common complication after cataract surgery, occurring in 1.2% to 13.2% of patients within the first five years.

Our study also found that the mean delay in surgery from presentation in patients less than 1 year of age is 1.45 years with a final post-operative BCVA of 0.764, in patients 1-3 years of age is 1.787 years with a final post op BCVA of 0.695, in patients >3 years of age is 1.857 years with a final post op BCVA of 0.677.

Hence it was seen that delay in surgery has no significant role in the final outcome when it is less than 1 year from age of onset according to our study.

In the study done by Jyoti Singh et al [15] they examined the long-term visual outcomes of children with dense bilateral congenital cataracts who underwent surgery between 2001 and 2006. The researcher categorised the timing of surgery based on age into three groups: within the first year of life, in the second year, and after two years. Surgery was performed in the first year of life in 106 eyes (69.3%). Surgery was performed in the second year in 20 eyes (13.1%). Surgery was performed after 2 years in 23 eyes (15%).

Summary and Conclusion

Congenital and developmental cataract is one of the leading treatable causes of low vision among children. Early intervention such as early surgery is key to overcome congenital or developmental cataract related blindness or low vision.

In India itself, congenital and developmental cataracts account for over 10-12% of childhood blindness, affecting approximately 3 out of every 10,000 newborns in India. The majority of patients presented with cataracts in our study are from underprivileged background which may have to do with either higher rates of maternal infections, or systemic diseases associated in this population.

Our study also shows that there was a positive correlation between the age of disease onset and age of presentation at hospital and visual acuity outcomes. The later the presentation or delay in seeking medical attention has much impact on the visual outcomes and related complications.

The surgical approaches varied significantly depending on age groups including IOL implantation, posterior capsulorhexis, and limited anterior vitrectomy in this study. The statistical analysis underscores the significance of treatment modality concerning the type of cataract and surgical approach but complication like PCO is common in patients who underwent cataract surgery without certain procedures such as PCC and LAV with a 43.75% incidence rate. Hence, positive correlation with surgical procedures was noted in our study but this could be very well associated with types of IOL used in the study.

Our study shows that the most cataracts could be detected and treated earlier with proper awareness. People in slums and remote areas need better education and counselling about cataract related blindness or low vision problems and complications to ensure both genders receive equal care from parents or families.

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