DOI: https://doi.org/10.54393/pjhs.v6i4.3091

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 04 (April 2025)

Original Article

OPEN ACCESS

Long-term Postoperative Outcomes of Pediatric Cataract Extraction with IOL Implantation in a Tertiary Eye Care Centre at Karachi

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ARTICLE INFO

Keywords:
IOL Implantation, Pediatric Cataract Extraction, Post-operative Outcomes, Amblyopia

How to Cite:
Uddin, M. M., Shah, S. H., Rameez, F., Khan, M. M., Azam, M., & Shaikh, S. A. (2025). Long-term Postoperative Outcomes of Pediatric Cataract Extraction with IOL Implantation in a Tertiary Eye Care Centre at Karachi: Postoperative Outcomes of Pediatric Cataract Extraction with IOL Implantation. Pakistan Journal of Health Sciences, 6(4), 125-129. https://doi.org/10.54393/pjhs.v6i4.3091

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Received Date: 6th March, 2025
Revised Date: 21st April, 2025
Acceptance Date: 23rd April, 2025
Published Date: 30th April, 2025

ABSTRACT

Cataracts in the pediatric age group present with challenges distinct from the adult age group. **Objectives:** To determine the long-term postoperative outcomes of pediatric cataract extraction with IOL implantation at a tertiary eye care center in Karachi. **Methods:** This retrospective cross-sectional study was carried out at Al-Ibrahim Eye Hospital for six months after ethical approval. Medical records of pediatric children below 10 years that had undergone cataract surgery along with implantation of IOL at the hospital in-between January 2020 to December 2024 were selected. Children having abnormalities, such as condition limiting eye's visual potential like retinal disorders, retinal detachment, glaucoma, persistent fetal vasculature, abnormalities of the cornea, diseases of optic nerve, uveitis (either active or signs suggesting history of uveitis), or a history of cryotherapy for retinopathy due to prematurity, or treatment with laser, children with complications of surgery, placement of IOL in sulcus or children that failed to follow-up were all excluded. SPSS version 23.0 was used for data analysis. **Results:** A total of 140 eyes from pediatric patients were studied, with 56.43% male and 43.57% female. Bilateral cataracts were more common (72.86%). The mean age at surgery was 74.77 ± 29.94 months, with a follow-up of 5.22 ± 3.82 months. Postoperative refractive biometry significantly improved from +24.50 ± 4.50 D to +18.50 ± 2.50 D ($p<0.001$), showing a mean reduction of -6.00 ± 2.00 D. **Conclusions:** In long-term post-operative outcomes of pediatric cataract extraction with IOL implantation, surgery was generally well-tolerated with positive outcomes and minimal side effects.

INTRODUCTION

Cataracts in the pediatric age group present with challenges distinct from the adult age group. The leading cause of childhood blindness is associated with pediatric cataracts. The clinical manifestations in terms of pediatric cataract tend to be broad-spectrum [1]. The degree of amblyopia varies between them. Pediatric cataracts are either developmental or congenital. It is crucial to note the cataract's laterality, either being unilateral or bilateral [2]. The importance lies in the timing for optimal interventions. Provided the continuous growth of pediatric eyes, it is imperative to check each child's stages of ocular development, in addition to any co-existence of ocular and systemic comorbidities [3]. Through surgery, multiple techniques ought to be considered, for instance, using an intraocular lens (IOL) along with its power. In addition, strategies for managing anterior vitreous and posterior capsule can be implemented [4]. Infantile eyes are post-operatively more prone towards an inflammatory response

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of greater severity. Swift rehabilitation of vision is vital, emphasizing therapy of amblyopia and adjustments to refractive index [5]. Moreover, pediatric eyes are considered to be at higher risk such as secondary glaucoma and opacification of the visual axis [6]. In patients having significant cataract (visually), surgical intervention should be carried out as early as possible to remove opacity of the lens along with effectively correcting aphakia [7]. It is the key towards a successful rehabilitation of vision [8]. Primary implantation of IOL has become an increasingly carried out surgical technique and at present, the preferred mode for correcting optical errors amongst pediatric eyes undergoing surgery for cataract [9]. Although it is the most commonly practiced procedure, there exists no consensus with regards to the optimum refractive goal for visual rehabilitation immediately after operation [10]. Even after advances in surgical methods recently, design of implant and instrumentation, a major challenge of cataract surgery among the pediatric age group is obtaining a desirable long-term refractive status post-operatively [11]. Long-term monitoring of pediatric eyes is recommended, owing to their immature nature and continued growth post-surgery [12]. In the event of the identification of prognostic factors, it is important to contemplate multiple factors in addition to demographics. Both physiological and anatomical confounding variables should be considered [13]. In one of the studies by Dahan and Drusedau, it was proposed that IOL power under-correction should be labelled when it is 20 % less than the ametropic power of IOL in pediatric ages below 2 years, while less than 10 % for pediatric ages over 2 years [14]. Another study proposes targeting refraction post-operatively at 6+6 D in 1 year olds, for 2 year olds, +5 D, for 3 year olds +4 D, for 4 year olds +3 D, for 5 year olds +2 D, for 6 year olds +1 D, for 7 year olds -1 D while for 8 years and older, -2 D [15]. Despite advancements in pediatric cataract surgery and intraocular lens (IOL) implantation techniques, limited data exist on the long-term visual and refractive outcomes in children, particularly in low- and middle-income countries. Most available studies focus on short-term postoperative results or are restricted to small sample sizes and narrow follow-up periods.

Furthermore, there is a lack of region-specific evidence addressing postoperative complications, visual rehabilitation, and quality of life in pediatric patients. This gap highlights the need for comprehensive, long-term follow-up studies that can inform surgical practices, guide parental counselling, and support health policy development in pediatric ophthalmology. This study aims to determine the long-term postoperative outcomes of pediatric cataract extraction with IOL implantation at a tertiary eye care center in Karachi.

METHODS

This retrospective cross-sectional study was carried out at the Al-Ibrahim Eye Hospital Karachi for six months after ethical approval from the Research Ethical Committee (REC) of the institute (REC/IPIO/2024/088). After ethical approval, medical records of pediatric children below the age of 10 years that had undergone cataract surgery along with implantation of IOL at the hospital in-between January 2020 to December 2024 were selected for review. A written informed consent was taken. Children without any other abnormality of the eye were included. In addition, children who had undergone aspiration of lens along with primary implantation of IOL, anterior vitrectomy and posterior capsulotomy were also included in the study. In all the patients, the IOL was kept in the capsular bag. Using immersion ultrasound (A-scan), the axial length of the eye was measured pre-operatively. For determining the power of IOL, SRK/T formula was used for all patients. Children having other abnormalities of the eye, such as condition limiting eye's visual potential like retinal disorders, retinal detachment, glaucoma, persistent fetal vasculature, abnormalities of the cornea, diseases of optic nerve, uveitis (either active or signs suggesting history of uveitis), or a history of cryotherapy for retinopathy due to prematurity, or treatment with laser, children with complications of surgery, placement of IOL in sulcus or children that failed to follow-up were all excluded from the research. Under corrected power of the IOL was calculated, anticipating the expected shift of myopia. The sample size for the study was calculated using the Open Epi online software for sample size calculation. Keeping the frequency of complications following pediatric cataract extraction and IOL implantation at 10 %, the sample size came out to be 140 at a 95 % confidence level. Therefore, a total of 140 patient data points were included in this research [16]. After ethical approval, the data of patients were included according to the inclusion and exclusion criteria. Collected data included baseline demographics, outcomes of surgery in terms of pre-, peri- and post-operative assessment and complications and visual outcomes. Moreover, post-operative refraction was also noted. The primary measure of outcome was refractive errors post-operatively in pseudophakic eyes. Refractive index was obtained at pre-operative and then at 6 months post-operatively. The outcomes were measured in terms of opacification of visual axis, myopic shift, glaucoma, retinal detachment, capsulophimosis, endophthalmitis and IOL decentration. SPSS version 23.0 was used for analyzing the data. Results were recorded as mean and standard deviation. The errors of refraction were measured as spherical power in D (diopters). The study excluded cylindrical power as changes in power of astigmatism were unrelated to emmetropization of spherical errors. The difference between pre- and post-operative reduction in

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IOL refraction was tested by applying a paired t-test, keeping p<0.050 statistically significant.

RESULTS

The baseline demographic and clinical characteristics of the pediatric patients included in the study are presented. A total of 140 eyes were analyzed. Among these, 79 (56.43%) belonged to male patients, while 61 (43.57%) were from female patients. The laterality of the cataracts showed that 38 eyes were affected unilaterally, whereas 102 eyes were from cases of bilateral cataracts. The mean age at the time of surgery was 74.77 ± 29.94 months, ranging from 6 to 118 months. The mean follow-up duration was 5.22 ± 3.82 months, ranging between 1 to 6 months (Table 1).

Table 1: Baseline Demographics of Pediatric Cataracts Included in the Study (n=140)

Baseline Characteristics		Frequency (%) / Mean ± SD
Gender	Male	79 (56.43 %)
	Female	61 (43.57 %)
Laterality	Unilateral	38
	Bilateral	102
Mean Age at Time of Surgery	6-118 Months	74.77 ± 29.94
Mean Follow-Up Time	1-6 Months	5.22 ± 3.82

In comparison between pre-operative and post-operative refractive biometry values, the mean pre-operative refractive biometry was +24.50 ± 4.50 diopters (D), which significantly reduced post-operatively to +18.50 ± 2.50 D (p<0.001). This reflects a mean reduction in refractive biometry of -6.00 ± 2.00 D, indicating a statistically significant improvement following intraocular lens (IOL) implantation (Table 2).

Table 2: Mean Pre- and Post-Operative Refractive Error Reduction (n=140)

Measurement		Mean ± SD (Diopters)	p-value
Refractive Biometry (D)	Pre-Operative	+ 24.50 ± 4.50 D	<0.001
	Post-Operative	+ 18.50 ± 2.50 D	
	Mean Reduction	- 6.00 ± 2.00 D	

Findings illustrate the long-term post-operative outcomes following cataract extraction and IOL implantation in the pediatric population. The highest frequency of post-operative long term complications was reported to be myopic shift, in 59 (42.14 %) (Figure 1).

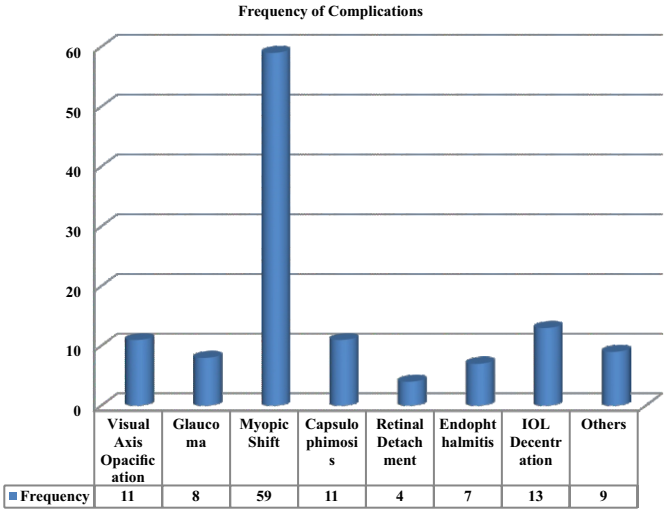

Figure 1: Post-Operative Long Term Outcomes of Pediatric Cataracts After IOL Implantation (n=140)

DISCUSSION

The results of the study showed a significant reduction in refractive biometry post-operatively (6 months) after cataract extraction and IOL implantation. The highest frequency of post-operative complications in the long term (6 months) was reported to be myopic shift, observed in 59 (42.14 %) of patients. The study was in line with guidelines proposed by a study in which Asian children were reported to develop myopia in the long term when compared with other populations [17]. 9 (6.43 %) patients were reported to have amblyopia in this study. Since the approach used in this study might raise concerns regarding residual hypermetropia, which might exacerbate amblyopia refractively amongst children. This is specifically for children having unilateral cases who might not wear spectacles or contact lenses post-surgically [18]. In this study, only 09 (6.43 %) cases were found to have amblyopia. Similar to the findings of this study, Wójcik-Niklewska *et al.*, reported that the majority of children tolerate spectacles well, even if they have a high difference in refractive power in-between eyes [19]. Therefore, amblyopia progression after under-corrected IOL power post-insertion is observed to be rare [20]. Moreover, pediatric eyes show continuous growth and tend to approach binocular vision; emmetropia and stereopsis seldom tend to improve [21]. A study reported that above 60 % of eyes tend to become myopic post-surgically. Studies have reported that the age of children at the time of surgery plays a vital role in determining the post-operative status of refraction. Irving et al., in a research on pediatric cataracts, found be myopic shift post-surgically among younger children. Those operated after the age of 5 years or more show lower refractive errors [22]. For instance, Lekskul *et al.*, observed a mean refractive error of - 2.50 ± 2.08 D among children aged 1-2 years, while – 0.45 ± 0.64 D among children aged 8-

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9 years [23]. A possible explanation for such postoperative myopic shift are the challenges in measuring ocular parameters such as keratometry and axial length amongst younger children, which might cause greater errors in calculating the power of IOL.The majority of studies have been found to follow this pattern, which is in line with the findings of this study [24].However, Khokhar *et al.*, reported that hypermetropia among children <2 years showed lesser under-correction among the age group. The study concluded further research to confirm the trend in refractive errors amongst the same group of age group [25]. Apart from myopia, 11 cases in current study observed opacification of the visual axis and capsulotomy each, and 13 were reported to have decentration of the IOL. Less common complications observed in the study were glaucoma, endophthalmitis, amblyopia and retinal detachment.Similar reports have been observed in the published literature as well [26].

The study was limited by its retrospective design, single-center setting, relatively short and variable follow-up duration despite being labeled long-term, and exclusion of complex ocular comorbidities, which may reduce generalizability. Additionally, broader functional outcomes such as quality of life and detailed visual acuity progression were not comprehensively assessed. Future multicenter prospective studies with extended follow-up, larger diverse populations, and inclusion of broader rehabilitation outcomes are recommended to strengthen evidence for pediatric cataract management and optimize long-term care strategies.

CONCLUSIONS

It was concluded that in long term post-operative outcomes of pediatric cataract extraction with IOL implantation, surgery was generally well-tolerated with positive outcomes and minimal side effects.

Authors' Contribution

Conceptualization: SHS, SAS
Methodology: MMU, SHS, MA
Formal analysis: MMK
Writing and Drafting: MMU, FR
Review and Editing: MMU, SHS, MA, SAS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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