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ORIGINAL ARTICLE

Visual Outcome of Cataract Surgery in Children with Traumatic Cataract: A Cross-Sectional Study

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ABSTRACT

Objective: The study aimed to assess the visual outcomes following cataract surgery in children diagnosed with traumatic cataracts.

Methods: A cross-sectional study was conducted at the Isra Postgraduate Institute of Ophthalmology, Karachi, from December 2020 to June 2021. Children aged 5 to 15 years with traumatic cataract underwent cataract surgery were included in the study. Postoperative visual outcomes were assessed by measuring best-corrected visual acuity (BCVA) at day 1, week 1, week 4, and week 6 after surgery. Visual outcomes were categorized as ≤6/60, 6/36, 6/24, or 6/18 or better. Baseline data, including demographic details (age, gender, and residence), affected eye, type and cause of trauma, cataract morphology, preoperative intraocular pressure (IOP), and time interval between trauma and surgery (1 week to <1 month, 1 month to 1 year, >1 year) were recorded.

Results: Of total 163 children, the mean age was 9.67 ±2.34 years. At baseline, 149 (91.4%) of patients had BCVA ≤6/60. After excluding cases lost to follow-up, 110 patients remained. Postoperative visual improvement was observed progressively, with 94 (85.5%) achieving BCVA of 6/18 or better at six weeks (p-value < 0.001). Age >10 years (p-value 0.045), blunt trauma (p-value < 0.001), normal preoperative IOP (p-value < 0.001), and surgery within 1 month to 1 year post-trauma (p-value < 0.001) were significantly associated with better visual outcomes.

Conclusion: Cataract surgery in children with traumatic cataracts resulted in significant visual improvement, with better outcomes observed in those with older age, blunt trauma, normal IOP, and timely intervention.

Keywords: Cataract Extraction, Pediatric Ophthalmology, Traumatic Cataract, Treatment Outcome, Visual Acuity.

INTRODUCTION

Pediatric cataract is an important cause of visual impairment in children. The causes of pediatric cataract are varied ranging from hereditary, idiopathic, ocular anomalies, multisystem syndromes, metabolic disorders, maternal infection, toxic effect of medication and trauma.[1,2] Traumatic cataract is defined as permanent opacity of the lens caused by blunt or penetrating eye trauma.[3] The majority of traumatic cataracts are intumescent; however, their classification and progression vary based on the mechanism of injury and the condition of the capsular bag. The classic presentation of traumatic cataracts is characterized by a rosette or stellate pattern.[4] Reports indicate that the incidence of ocular trauma among children ranges between 0.746 and 9.9 per 10,000 in the United States and other developed nations.[5]

Ocular trauma is a significant cause of monocular blindness, affecting individuals in both developed and developing countries.[6] It accounts for a considerable proportion of vision impairment and preventable blindness worldwide.[7,8] Among various complications resulting from ocular injuries, traumatic cataract is particularly concerning, especially in the pediatric population, due to its impact on visual development and long-term visual prognosis.[9,10] Traumatic cataract is a treatable condition, and its proper management plays a crucial role in reducing the global burden of blindness.[2-4] Early diagnosis and timely surgical intervention are essential to prevent long-term visual impairment, particularly in children, where delayed treatment can lead to amblyopia, strabismus, and irreversible vision loss.[11] In addition to cataract extraction, postoperative refractive error correction is a key factor in achieving optimal visual rehabilitation.[12]

Prompt management of traumatic cataracts and appropriate refractive correction contribute to favorable visual outcomes.[3] In many cases, cataract surgery is required when the opacity obstructs the visual axis. However, minor lens injuries may lead to localized, stable opacities that do not necessitate surgical intervention. Zonular damage can also occur, resulting in lens subluxation or complete dislocation, which may require surgical management.[6]

This study aimed to assess the visual outcomes of cataract surgery in children with traumatic cataracts at a tertiary eye care hospital in Karachi. While similar studies have been conducted at the regional level in recent years, there is a lack of local data on surgical outcomes in pediatric traumatic cataracts. By assessing postoperative visual improvement, this study aims to provide valuable insights into the effectiveness of early intervention and management strategies. The findings will contribute to reducing the risk of amblyopia, strabismus, and blindness in children, ultimately helping to improve visual acuity and long-term quality of life.

METHODS

This cross-sectional study was carried out in the Pediatric Ophthalmology Department at the Isra Postgraduate Institute of Ophthalmology (IPIO), Karachi, between December 2020 and June 2021. Approval was granted by the institutional ethics committee (Ref #: REC/IPIO/2020/005). Informed written consent was obtained from all participants or their guardians.

A sample size of 163 was determined using the OpenEpi calculator, with a 95% confidence level, a 5% margin of error, and an estimated prevalence of 88%,[13] derived from prior research on pediatric traumatic cataracts. Participants were recruited using non-probability, consecutive sampling.

The inclusion criteria consisted of children aged 5 to 15 years with traumatic cataracts of any duration or severity. Cases were excluded if traumatic cataracts were associated with vision-threatening complications such as central corneal scarring, secondary glaucoma, vitreous hemorrhage, retinal detachment, choroidal rupture, or optic nerve avulsion. Additional exclusions included chemical injuries, pre-existing poor vision unrelated to trauma as per medical history, and refusal to provide consent.

Patients who met the inclusion criteria and presented for cataract surgery were enrolled in the study. Baseline data, including demographic details (age, gender, and residence), the affected eye, type and cause of trauma, and the morphology of cataract, were collected using a structured proforma. Preoperative parameters such as best-corrected visual acuity (BCVA), intraocular pressure (IOP), and axial length (measured via B-scan ultrasonography) were documented.

Traumatic cataract is defined as a permanent opacity of the crystalline lens resulting from blunt or penetrating ocular trauma, leading to visual impairment requiring surgical intervention. Diagnosis is confirmed through slit-lamp biomicroscopy, identifying features such as lens opacification, capsular rupture, irregular lens contour, or associated ocular injuries. In this study, surgical management includes lens matter aspiration with or without posterior capsulotomy and anterior vitrectomy, intraocular lens (IOL) implantation (primary or secondary), and/or pars plana lensectomy, as required. The site of IOL implantation (sulcus, bag, or trans-scleral fixation), the type of IOL (polymethyl methacrylate or acrylic), and IOL power are also recorded.

Postoperative visual outcomes were assessed by measuring BCVA at specified follow-up intervals, including the first postoperative day, one week, four weeks, and six weeks after surgery. The outcomes were categorized as ≤6/60, 6/36, 6/24, or 6/18 or better. Data regarding the interval between trauma and cataract surgery were also collected and categorized as 1 week to <1 month, 1 month to 1 year, >1 year. All clinical examinations, including visual acuity assessments, were performed by a qualified pediatric ophthalmologist using standard techniques.

Data entry and analysis were conducted using Statistical Package for Social Sciences (SPSS) version 20.0. Mean and standard deviation were calculated for quantitative variables such as age, while categorical variables, including gender, residence, affected eye, type and cause of trauma, cataract morphology, preoperative BCVA, preoperative IOP, axial length, interval between trauma and surgery, IOL power, and visual outcomes, were presented as frequencies and percentages. Cochran's Q test was applied to assess postoperative visual outcomes over time, while Chi-square/Fisher's exact test was used to examine associations between visual outcomes at six weeks and patients' demographic and clinical characteristics. A p-value of ≤0.05 was considered statistically significant.

RESULTS

Of total 163 children, the mean age was 9.67 ±2.34 years. There were 120 (73.6%) males and 43 (26.4%)

females. The majority of children resided in rural areas 107 (65.6%) and had trauma affecting their left eye 84 (51.5%). Blunt trauma was the most common type 117 (71.8%), with object-related injuries being the leading cause 126 (77.3%). Total cataract was observed in 100 (61.3%) cases and in most patients, the interval between trauma and surgery ranged from one month to one year 89 (54.6%). Preoperatively, 149 (91.4%) had a BCVA of ≤6/60, while 85 (52.1%) had normal IOP, 88 (54.0%) had a normal axial length, and 148 (90.8%) had a normal IOL power.

Table 1 presents the preoperative and postoperative visual status (BCVA) of children. At baseline, most patients had a BCVA of ≤6/60 i.e., 149 (91.4%), with none achieving 6/18 or better. However at day 1, 26 (16.0%) achieved BCVA 6/18 or better. At week 1, 100 (67.1%) achieved BCVA 6/18 or better with 14 (8.6%) patients loss to follow-up. At week 4, 97 (78.2%) achieved BCVA 6/18 or better with 39 (23.9%) patients loss to follow-up. At week 6, 94 (85.5%) achieved 6/18 or better, though loss to follow-up increased to 53 (32.5%).

After excluding cases lost to follow-up, 110 patients remained. A significant improvement in BCVA was observed over time, with patients achieving BCVA 6/18 or better increasing from 25 (22.7%) on day 1 to 80 (72.7%) at week 1, 87 (79.1%) at week 4, and 94 (85.5%) at week 6 (p-value < 0.001). A similar trend was observed when stratified by trauma type, with both blunt and penetrating trauma groups showed improved visual outcome over time (Table 2).

At the final follow-up (week 6), visual outcomes were significantly associated with several clinical and demographic factors. Patients aged >10 years (p-value 0.045), those with blunt trauma (p-value < 0.001), normal preoperative intraocular pressure (p-value < 0.001), and those who underwent surgery within one month to one year of trauma (p-value < 0.001) were more likely to achieve better visual outcomes (Table 3).

Table 1: Preoperative and postoperative best-corrected visual acuity (BCVA) at different follow-up intervals

Follow-Up Interval	≤6/60 n (%)	6/36 n (%)	6/24 n (%)	6/18 or better n (%)	Lost to Follow-Up n (%)
Pre-Operative (n= 163)	149 (91.4)	3 (1.8)	11 (6.8)	0 (0.0)	0 (0.0)
Day 1 (n= 163)	100 (61.3)	31 (19.0)	6 (3.7)	26 (16.0)	0 (0.0)
Week 1 (n= 149)	29 (19.5)	0 (0.0)	20 (13.4)	100 (67.1)	14 (8.6)
Week 4 (n= 124)	4 (3.2)	0 (0.0)	23 (18.5)	97 (78.2)	39 (23.9)
Week 6 (n= 110)	3 (2.7)	0 (0.0)	13 (11.8)	94 (85.5)	53 (32.5)

-All data presented as frequency (percentage), BCVA: Best-corrected visual acuity

Table 2: Trends in visual outcome (BCVA) over time after cataract surgery

Follow-Up Interval	Visual Outcome		p-value
	Poor n (%)	Improved n (%)	
Total (n= 110)			
Day 1	85 (77.23)	25 (22.7)	<0.001*
Week 1	30 (27.3)	80 (72.7)	
Week 4	23 (20.9)	87 (79.1)	
Week 6	16 (14.5)	94 (85.5)	
Type of Trauma			
Blunt (n= 75)			
Day 1	55 (73.3)	20 (26.7)	<0.001*
Week 1	21 (28.0)	54 (72.0)	
Week 4	10 (13.3)	65 (86.7)	
Week 6	3 (4.0)	72 (96.0)	
Penetrating (n= 35)			
Day 1	30 (85.7)	5 (14.3)	<0.001*
Week 1	9 (25.7)	26 (74.3)	
Week 4	13 (37.1)	22 (62.9)	
Week 6	13 (37.1)	22 (62.9)	

-BCVA: Best-corrected visual acuity, BCVA ranging from ≤6/60 to 6/24 is classified as a poor visual outcome, while 6/18 or better is classified as an improved visual outcome

* p-value ≤ 0.05 (Cochran's Q test)

Table 3: Association of visual outcome at 6 weeks with demographic and clinical characteristics (n = 110)

	Total	Visual Outcome at 6th week		p-value
		Poor (n= 16)	Improved (n= 94)	
Age (years)	9.67 ±2.34	9.06 ±1.52	10.15 ±2.29	0.022$*
≤10	72	14 (19.4)	58 (80.6)	0.045^*
>10	38	2 (5.3)	36 (94.7)	
Gender				
Male	77	9 (11.7)	68 (88.3)	0.194~
Female	33	7 (21.2)	26 (78.8)	
Residence				
Rural	67	10 (14.9)	57 (85.1)	0.888^
Urban	43	6 (14.0)	37 (86.0)	
Affected Eye				
Left	49	9 (18.4)	40 (81.6)	0.308 ^
Right	61	7 (11.5)	54 (88.5)	
Type of Trauma				
Blunt	75	3 (4.0)	72 (96.0)	<0.001~*
Penetrating	35	13 (37.1)	22 (62.9)	
Cause of Trauma				
Animal Related	17	3 (17.6)	14 (82.4)	0.559~
Object Related	87	13 (14.9)	74 (85.1)	
Physical Accident	6	0 (0.0)	6 (100.0)	
Morphology of Cataract				
Posterior Sub capsular Cataract	10	3 (30.0)	7 (70.0)	0.197^
Rosette	37	3 (8.1)	34 (91.9)	
Total Cataract	63	10 (15.9)	53 (84.1)	
Pre-Operative BCVA				
≤6/60	103	16 (15.5)	87 (84.5)	0.529~
6/24	4	0 (0.0)	4 (100.0)	
6/36	3	0 (0.0)	3 (100.0)	
Pre IOP (mm Hg)	11.18 ±1.38	10.38 ±0.81	11.45 ±1.51	<0.001$*
Low (≤10)	48	13 (27.1)	35 (72.9)	<0.001^*
Normal (11 to 14)	62	3 (4.8)	59 (95.2)	
Axial Length (mm)	22.54 ±1.05	22.75 ±0.63	22.50 ±1.05	0.367$
Short (<22)	20	0 (0.0)	20 (100.0)	0.124~
Normal (22 to 24.5)	57	10 (17.5)	47 (82.5)	
Long (>24.5)	33	6 (18.2)	27 (81.8)	
Interval between Trauma and Surgery				
1 week to <1 month	42	6 (14.3)	36 (85.7)	<0.001^*
1 month to 1 year	58	3 (5.2)	55 (94.8)	
>1 year	10	7 (70.0)	3 (30.0)	
Power of IOL (Diopters)				
Normal (15 to 25)	100	16 (16.0)	84 (84.0)	0.171~
High (>25)	10	0 (0.0)	10 (100.0)	

-Quantitative variables described by mean ±SD, Categorical variables described by frequencies (percentages), BCVA: Best-corrected visual acuity, IOL: intraocular lens, IOP: Intraocular pressure, BCVA ranging from ≤6/60 to 6/24 is classified as a poor visual outcome, while 6/18 or better is classified as an improved visual outcome

***** p-value ≤ 0.05 (^Chi-Square/~Fisher Exact test and $Independent Sample t-test)

DISCUSSION

The findings of this study demonstrate that cataract surgery significantly improves visual acuity in children with traumatic cataracts, with 85.5% of patients achieving a BCVA of 6/18 or better by the sixth postoperative week. These results are consistent with previously published studies that have reported favorable outcomes with timely surgical intervention and structured postoperative care in pediatric traumatic cataracts.[13,14] A study has conducted at tertiary care institute in northern India, in which researchers analyzed medical records of 147 children less than 15 years with traumatic cataracts who underwent cataract surgery between 2004 to 2012. Visual acuity postoperatively at 4 weeks was recorded in a total of 107 patients, out of which sixty two percent achieved ≥6/18 and eighty eight percent achieved >6/60.[13] A One more study found no significant differences in postoperative BCVA or major intraoperative and postoperative complications between early and late traumatic cataract surgeries with IOL implantation following open globe injuries.[14]

A key observation in this study is the influence of multiple factors on the visual outcome. Children older than 10 years were more likely to have better visual recovery, which could be attributed to their more mature visual system and greater ability to comply with postoperative care, as also noted in studies by Shah *et al.* and Chowdhary *et al.*[15,16]

An essential component of pediatric cataract rehabilitation is appropriate refractive correction and amblyopia therapy, which are often underemphasized. Uncorrected postoperative refractive errors and delayed initiation of amblyopia therapy may hinder visual recovery, especially in younger children with higher neuroplasticity. Although this study did not quantify adherence to refractive correction and amblyopia management, these aspects remain critical in achieving optimal outcomes. Future studies should incorporate follow-up data on prescription compliance, patching regimens, and visual therapy, as these interventions can significantly influence long-term visual acuity.

Additionally, patients with blunt trauma had significantly better visual outcomes compared to those with penetrating injuries in this study. This is likely due to the more extensive ocular damage caused by penetrating trauma, which often results in complications such as posterior capsule rupture, retinal detachment, and intraocular inflammation, as reported by Tabatabaei *et al.* and Qiu *et al*.[14,17]

The timing of surgery also played a critical role in visual prognosis. Patients who underwent cataract extraction within one month to one year post-trauma had better visual recovery, whereas delays beyond one year were associated with significantly poorer outcomes. These findings underscore the importance of timely surgical intervention to prevent irreversible amblyopia, which is a well-documented risk in pediatric cataract cases as reported by Du *et al*.[18] Moreover, Zimmermann *et al*. also supports recommendations for early surgical management to optimize visual rehabilitation and prevent long-term visual impairment.[19]

In this study factors significantly associated with improved visual outcomes included age >10 years, blunt trauma, normal preoperative intraocular pressure, and an interval between trauma and surgery of 1 month to 1 year. In contrast, the study by Goyal *et al.* focused on prediction error in pediatric traumatic cataract surgeries and found that absolute prediction error was higher in eyes with shorter axial lengths, while factors such as age at surgery, biometry method, duration of injury, type of cataract surgery, and IOL position did not significantly affect prediction error. Their study also highlighted that in cases of corneal scarring, using keratometry readings from the fellow eye resulted in a lower prediction error compared to standard keratometry values.[20]

Despite the positive outcomes, this study highlights several challenges. This study did not focus primarily on postoperative complications, data regarding intraoperative and postoperative complications such as posterior synechiae, endophthalmitis, capsular phimosis, or posterior capsular opacification were not systematically collected or analyzed. Monitoring such complications is important, particularly in pediatric cases where inflammatory responses are more pronounced. Secondly, a considerable proportion of patients were lost to follow-up by the sixth week, which may limit the generalizability of the findings. Improved patient adherence to follow-up visits is crucial for optimizing postoperative care and addressing complications promptly. Additionally, visual recovery was suboptimal in 14.5% of cases, indicating that factors such as amblyopia, corneal scarring, and posterior segment involvement continue to pose challenges in managing traumatic cataracts in children.

Overall, this study reinforces the importance of early diagnosis, timely surgical intervention, and appropriate postoperative care in optimizing visual outcomes in pediatric traumatic cataract cases. Future studies with longer follow-up durations and larger sample sizes are warranted to further explore the long-term effects of

different surgical techniques and rehabilitation strategies in this patient population.

CONCLUSION

This study demonstrate that cataract surgery effectively enhances visual outcomes in children with traumatic cataracts. Factors such as age at surgery, nature of trauma, preoperative intraocular pressure, and timing of intervention played a crucial role in postoperative visual recovery. These results reinforce the importance of early detection, timely surgical management, and comprehensive preoperative assessment in optimizing vision and minimizing long-term complications in pediatric patients.

ETHICAL APPROVAL: This study was approved by the Research Ethical Committee of Isra Postgraduate Institute of Ophthalmology (Registration No. REC/IPIO/2020/005, dated: 1st September, 2020).

AUTHORS' CONTRIBUTIONS: AAM, MA, MC: Substantial contributions to the conception or design of the work. AAM, MA, SA: Acquisition, analysis, and interpretation of data; methodology. AAM, SM: Drafting the manuscript or revising it critically for important intellectual content. AAM, BRT: Provided supervision and/or project administration, including oversight of the research activity planning and execution. All authors critically reviewed and gave final approval of the manuscript.

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