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Pattern of anterior segment ocular injuries in children: A clinical study from a tertiary care centre in the Vindhya region of central India

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Abstract
Purpose: To analyze the epidemiological pattern, etiology, clinical profile, and visual outcomes of anterior segment ocular injuries in pediatric patients attending a tertiary care centre in the Vindhya region of Central India.
Methods: This prospective observational study was conducted on 100 pediatric patients (<18 years) with anterior segment ocular injuries attending the Department of Ophthalmology at a tertiary care hospital in the Vindhya region from January 2021 to June 2022. Detailed demographic data, mechanism and mode of injury, type of ocular involvement, and time of presentation were recorded. All patients underwent comprehensive ophthalmic examination including best corrected visual acuity (BCVA), slit-lamp biomicroscopy, tonometry, and fundus evaluation. Injuries were classified according to the Birmingham Eye Trauma Terminology System (BETTS). Patients were followed for three months, and final visual outcomes were assessed.
Results: The mean age of the patients was 10.5 ± 3.54 years (range: 3 months-18 years), with a male-to-female ratio of 2.1:1. The majority of injuries occurred in the 7-11 year age group (29%). Rural children (62%) and those from lower socioeconomic backgrounds (52%) were more frequently affected. The most common place of injury was home (48%), followed by school (17%) and road (16%). Trauma by sharp objects (33%) was the leading cause, followed by falls (24%) and blunt objects (21%). Closed globe injuries were more common (58.5%) than open globe injuries (41.5%). Penetrating trauma accounted for 86.3% of open globe injuries. Corneoscleral tears were the most frequent sight-threatening lesions. At presentation, 55.5% of eyes had poor visual acuity (LogMAR ≥ 1.0). After treatment and follow-up, 39.2% achieved BCVA ≥ 6/12. Better outcomes were associated with early presentation (<48 hours) and closed globe injuries ($p < 0.05$).
Conclusion: Anterior segment ocular trauma in children is a significant cause of preventable visual morbidity in Central India. Most injuries occur at home and are related to sharp or blunt objects during unsupervised play. Early medical attention and appropriate surgical intervention markedly improve visual prognosis. Community-based awareness and school screening programs are essential for early detection and prevention of childhood ocular injuries.

Keywords: Pediatric ocular trauma, anterior segment, open globe injury, closed globe injury, corneal tear, visual outcome, Vindhya region

Introduction

Ocular trauma remains a leading cause of acquired unilateral blindness among children worldwide. Pediatric eye injuries account for 8-14% of all childhood injuries, often resulting in permanent visual impairment and amblyopia due to delayed presentation or suboptimal management. The burden is particularly high in developing regions where lack of awareness, poor supervision, and limited access to prompt ophthalmic care exacerbate outcomes.

In India, regional variations in socioeconomic and cultural patterns influence the etiology and severity of ocular injuries. The Vindhya region, being largely agrarian and semi-urban, presents unique exposure risks for children. Despite this, data on pediatric anterior segment ocular injuries in this region are scarce.

This study aims to analyze the demographic characteristics, etiological factors, clinical features, and visual outcomes of anterior segment ocular injuries in children, providing insights into the patterns of ocular trauma specific to the Vindhya region.

Materials and Methods

Study design and setting

A prospective observational study was carried out at the Department of Ophthalmology, [Institution name], a tertiary care hospital in the Vindhya region of Central India, between January 2021 and June 2022.

Sample size

A total of 100 pediatric patients (<18 years) presenting with anterior segment ocular injuries were included after obtaining informed consent from parents or guardians.

Inclusion criteria

- Children below 18 years of age with anterior segment ocular trauma.
- Minimum follow-up period of three months.

Exclusion criteria

- Isolated posterior segment injuries.
- Thermal, chemical, electrical, radiational, or firecracker-related injuries.

Data collection

Demographic details, socioeconomic status (assessed using the modified Kuppuswamy scale, 2021), mode and cause of injury, time of presentation, and laterality were documented. A detailed ocular history and examination were performed, including BCVA (converted to LogMAR), slit-lamp evaluation, pupillary reaction, tonometry (in closed globe injuries), and fundus examination with +90 D lens and indirect ophthalmoscopy. Ultrasonography (B-scan) and radiological imaging were done when posterior segment or orbital involvement was suspected.

Classification: All injuries were categorized as open or closed globe according to the Birmingham Eye Trauma Terminology System (BETTS).

Management and follow-up

Patients were managed conservatively or surgically as indicated. Conservative treatment included topical and systemic antibiotics, cycloplegics, steroids, and lubricants. Surgical procedures included primary repair of corneal/corneoscleral tears, cataract extraction, or foreign body removal. Patients were followed at one week, one month, and three months post-treatment to record visual recovery and sequelae.

Statistical analysis

Data were analyzed using descriptive statistics (mean ± SD, frequency, and percentage). The paired t-test was applied to assess improvement in visual acuity and correlation with demographic and injury-related factors. A p-value < 0.05 was considered statistically significant.

Results

Demographics

The mean age was 10.5 ± 3.54 years (range: 3 months-18 years). The majority (29%) were aged 7-11 years, and 67% were male (M:F = 2.1:1). Rural children constituted 62% of cases, while 52% belonged to the lower socioeconomic class.

Etiology and place of injury

Most injuries occurred at home (48%), followed by school (17%) and roads (16%). Sharp objects were responsible for 33% of cases, blunt trauma for 21%, and falls for 24%. Among the specific objects, wooden sticks (20.3%), stones (16.6%), and bat-ball injuries (14.8%) predominated.

Type of injury

Closed globe injuries (58.5%) were more common than open globe injuries (41.5%). Among open globe cases, penetrating injuries (86.3%) were most frequent, followed by ruptures (9%) and intraocular foreign bodies (4.5%).

Clinical findings

- Corneal or corneoscleral tears: 39%
- Hyphema: 32%
- Traumatic cataract: 10%
- Traumatic uveitis: 11%
- RAPD: 19%
- Optic nerve involvement: 9%

Management

Conservative management was sufficient in 44.3% of eyes, while 49% required surgical intervention. Seven cases (6.7%) with posterior involvement were referred to higher centres.

Visual outcomes

At presentation, 55.5% of eyes had poor vision (LogMAR ≥ 1.0). At three-month follow-up, 39.2% of eyes achieved BCVA ≥ 6/12, while 27.5% remained below 6/60. Early presentation (<48 h) and closed globe injuries showed significantly better recovery ($p< 0.05$).

Sequelae: Corneal scar (69.5%) was the most frequent residual finding, followed by adherent leucoma (8.8%) and phthisis bulbi (6.6%).

Table 1: Summary of Key Clinical Findings and Visual Outcomes (n = 100)

Parameter	Frequency (%)	Key Observations
Mean age	10.5 ± 3.5 years	Peak at 7-11 years
Male: Female ratio	2.1:1	Male predominance
Rural residence	62%	Mostly lower SES
Closed: Open globe	58.5: 41.5	Penetrating most common (86%)
Presenting vision < 6/60	55.5%	Severe impairment at presentation
Final BCVA ≥ 6/12	39.2%	Significant visual recovery
Major sequelae	Corneal scar 69.5%, Adherent leucoma 8.8%	Persistent morbidity

Discussion

Pediatric ocular trauma continues to be a significant cause of preventable blindness in developing countries. The findings of the present study align with prior research showing a higher incidence among school-aged boys engaged in outdoor play without adequate supervision. The

male predominance (67%) and mean age (10.5 years) correspond with studies by Singh *et al*. (2017) [2] and Madan *et al*. (2020) [7], who reported similar demographics in central India.

Home and school were the most common sites of injury, reflecting both domestic hazards and lack of safety awareness. Sharp-object injuries were predominant, as previously documented by Qayum *et al*. and Puodžiuvienė *et al*., underscoring the vulnerability of children to penetrating trauma.

Closed globe injuries were more frequent, but open globe injuries, particularly penetrating corneal or corneoscleral tears, led to poorer visual outcomes. This parallels findings by Al-Haski *et al*. (2007) [3] and Akça Bayar *et al*. (2022) [8], emphasizing the prognostic significance of injury type and initial BCVA.

Visual prognosis was significantly influenced by time to presentation; children reporting within 48 hours achieved markedly better outcomes. Delayed presentation, common in rural areas due to limited access to specialized care, remains a major challenge.

Corneal scars and adherent leucomas were the most frequent sequelae, highlighting the long-term morbidity of anterior segment trauma. Although modern microsurgical techniques have improved outcomes, prevention through awareness and early management remains paramount.

Conclusion

Anterior segment ocular trauma in children is a major cause of preventable visual disability in the Vindhya region. Most injuries occur in the home environment and involve sharp objects. Early presentation and prompt management are associated with favorable visual outcomes. Community awareness, parental education, and integration of ocular trauma prevention into school health programs are vital to reduce the burden of childhood blindness.

Clinical Significance

Early detection, timely surgical intervention, and parental education can substantially reduce preventable blindness due to pediatric anterior segment injuries. Routine school eye screening and mandatory preoperative corneal evaluation before refractive surgeries are recommended to detect subtle or healed ocular trauma in children.

Ethical Clearance

The study was approved by the Institutional Ethics Committee of S.S. Medical College, Rewa, Madhya Pradesh, India, and adhered to the tenets of the Declaration of Helsinki.

(Approval number to be inserted.)

Financial Support and Sponsorship

Nil.

Conflicts of Interest

None declared.

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