

Ocular Manifestations in Patients of Head Injury Attending a Tertiary Care Trauma Centre: An Observational Cross-Sectional Study

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Abstract: ***Background:** Traumatic brain injury (TBI) remains a leading cause of trauma-related morbidity and mortality worldwide. Ocular involvement is frequently observed in head injury due to the close anatomical relationship between the visual apparatus and intracranial structures. These ocular manifestations may serve as important clinical indicators of injury severity and prognosis. **Methods:** This observational cross-sectional study was conducted at a tertiary care trauma centre over a period of 20 months. One hundred patients with clinically and radiologically confirmed head injury were included. A comprehensive ophthalmic evaluation encompassing adnexal, anterior segment, posterior segment, and neuro-ophthalmic assessment was performed in all patients. Neurological severity was graded using the Glasgow Coma Scale (GCS). Ocular findings were analysed and correlated with the severity and mechanism of head injury. **Results:** Ocular manifestations were identified in 68% of patients. Adnexal and anterior segment injuries were the most common findings, with periorbital ecchymosis (28%) and subconjunctival haemorrhage (22%) predominating. Posterior segment involvement was observed in 18% of patients, while neuro-ophthalmic manifestations were noted in 14%. Road traffic accidents accounted for the majority of cases (64%). A statistically significant association was observed between lower GCS scores and the presence of severe ocular manifestations ($p < 0.05$). **Conclusion:** Ocular manifestations are common in head injury patients and demonstrate a significant correlation with neurological severity. Routine ophthalmic evaluation should be integrated into trauma assessment protocols to enable early detection and prevent vision-threatening complications.*

Keywords: Head injury, ocular manifestations, trauma, neuro-ophthalmology, Glasgow Coma Scale

1. Introduction

Traumatic brain injury (TBI) represents a major global health burden and is a leading cause of death, disability, and long-term neurological sequelae, particularly among young adults [1]. The Global Burden of Disease Study estimates that millions of individuals suffer from TBI annually, with a disproportionate burden borne by low- and middle-income countries [1]. In India, the incidence of head injury is rising steadily, largely attributed to increasing road traffic accidents, inadequate enforcement of traffic safety regulations, and limited pre-hospital trauma care facilities [2,3].

The visual system is particularly vulnerable in head injury due to the anatomical proximity of the eyes, orbit, optic nerve, and visual pathways to the cranial vault. Consequently, ocular manifestations are frequently encountered in patients with head trauma. These manifestations range from minor adnexal injuries such as periorbital ecchymosis and subconjunctival haemorrhage to severe posterior segment and neuro-ophthalmic complications, including traumatic optic neuropathy, cranial nerve palsies, and retinal detachment [4–7].

Ocular findings in head injury patients are clinically important for several reasons. First, they may directly threaten vision and require urgent intervention. Second, certain ocular manifestations reflect the severity of underlying intracranial injury and may therefore serve as valuable prognostic indicators [6–9]. Previous studies have reported ocular involvement in 25–90% of head injury patients, with wide variation depending on study design, patient population, and diagnostic criteria [6–9].

The Glasgow Coma Scale (GCS) is the most widely used tool for assessing neurological severity in head injury patients. Several authors have demonstrated a correlation between lower GCS scores and increased frequency of posterior segment and neuro-ophthalmic involvement, suggesting that ocular findings may parallel the severity of brain injury [10–14].

Despite the high burden of head injury in India, systematic evaluation of ocular manifestations remains limited, and routine ophthalmic assessment is often overlooked in trauma settings. The present study was therefore undertaken to evaluate the prevalence and spectrum of ocular manifestations in head injury patients attending a tertiary care trauma centre and to correlate these findings with neurological severity as assessed by the GCS.

2. Materials and Methods

Study Design and Setting

An observational cross-sectional study was conducted at a tertiary care trauma centre over a period of 20 months.

Study Population

All consecutive patients with clinically and radiologically confirmed head injury were included. Patients with pre-existing ocular pathology, previous ocular surgery, or incomplete ophthalmic examination were excluded.

Sample Size

A total of 100 patients were enrolled.

Ethical Considerations

Approval was obtained from the Institutional Ethics Committee. Informed consent was taken from patients or their legal guardians.

Clinical Evaluation

Neurological assessment was performed using the Glasgow Coma Scale. Neuroimaging was carried out as indicated.

A comprehensive ophthalmic examination included:

- Adnexal and orbital evaluation
- Anterior segment examination
- Posterior segment examination using direct and indirect ophthalmoscopy
- Neuro-ophthalmic assessment including pupillary reactions and cranial nerve evaluation

Ocular injuries were classified according to the Birmingham Eye Trauma Terminology System.

Statistical Analysis

Data were analysed using SPSS version 25. Categorical variables were expressed as frequencies and percentages. Associations between ocular findings and GCS were assessed using chi-square test. A p-value <0.05 was considered statistically significant.

3. Results

Demographic Profile

A total of 100 patients with head injury were included in the study. The mean age of the study population was 34.2 ± 12.6 years, with an age range of 5–70 years. There was a clear male predominance, with males comprising 72% of the cohort and females 28%, resulting in a male-to-female ratio of approximately 3:1. This likely reflects greater exposure of males to road traffic, outdoor occupations, and high-risk activities.

Table 1: Demographic Details

| Variable | Number of patients | Percentage (%) |
|-------------------|-----------------------|----------------|
| Age (years) | | |
| 0–10 | 6 | 6 |
| 11–20 | 16 | 16 |
| 21–40 | 48 | 48 |
| 41–60 | 22 | 22 |
| >60 | 8 | 8 |
| Sex | | |
| Male | 72 | 72 |
| Female | 28 | 28 |
| Mean age \pm SD | 34.2 \pm 12.6 years | |

The most commonly affected age group was 21–40 years (48%), followed by 41–60 years (22%), indicating increased vulnerability among the economically productive population. Children below 10 years constituted 6% of cases, while patients above 60 years accounted for 8%, with falls being the predominant mechanism in these age groups.

Aetiology of Head Injury

Road traffic accidents (RTAs) were the most common cause of head injury, accounting for 64% of cases. Falls were the second most frequent cause (20%), particularly among

paediatric and elderly patients. Assaults contributed to 10% of cases, while other causes such as sports-related and occupational injuries accounted for 6%.

Table 2: Aetiology of Head Injury

| Cause | Number of patients | Percentage (%) |
|-----------------------|--------------------|----------------|
| Road traffic accident | 64 | 64 |
| Fall | 20 | 20 |
| Assault | 10 | 10 |
| Others | 6 | 6 |
| Total | 100 | 100 |

RTAs were more frequent among males and peaked in the 21–40-year age group. Falls were proportionally higher in children and elderly patients, suggesting age-related vulnerability and environmental factors.

Severity of Head Injury

Neurological severity at admission was assessed using the Glasgow Coma Scale (GCS).

- Mild head injury (GCS 13–15) was observed in 54 patients (54%)
- Moderate head injury (GCS 9–12) in 28 patients (28%)
- Severe head injury (GCS \leq 8) in 18 patients (18%)

Patients injured in road traffic accidents demonstrated a higher proportion of moderate to severe head injuries, whereas falls and assaults were more commonly associated with mild head injury.

Prevalence and Spectrum of Ocular Manifestations

Ocular manifestations were identified in 68 patients (68%), underscoring their high prevalence in head injury. The spectrum of ocular findings is detailed in Table 3.

Pattern of Ocular Involvement

Adnexal and orbital involvement was observed in 44% of patients, with periorbital ecchymosis being the most frequent finding (28%), followed by lid lacerations (10%) and orbital fractures (6%). These findings were more common in patients with mild to moderate head injury.

Table 3: Spectrum of ocular manifestations

| Ocular finding | Number of patients | Percentage (%) |
|-----------------------------|--------------------|----------------|
| Adnexal/orbital | | |
| Periorbital ecchymosis | 28 | 28 |
| Lid lacerations | 10 | 10 |
| Orbital fractures | 6 | 6 |
| Anterior segment | | |
| Subconjunctival haemorrhage | 22 | 22 |
| Corneal abrasion | 6 | 6 |
| Hyphema | 4 | 4 |
| Posterior segment | | |
| Comotio retinae | 8 | 8 |
| Papilledema | 6 | 6 |
| Retinal detachment | 4 | 4 |
| Neuro-ophthalmic | | |
| Cranial nerve palsies | 8 | 8 |
| Traumatic optic neuropathy | 4 | 4 |
| Abnormal pupillary reflexes | 2 | 2 |
| Total with ocular findings | 68 | 68 |

Anterior segment involvement was noted in **32%** of patients. Subconjunctival haemorrhage was the most common anterior segment finding (**22%**), followed by corneal abrasions (**6%**) and Hyphema (**4%**).

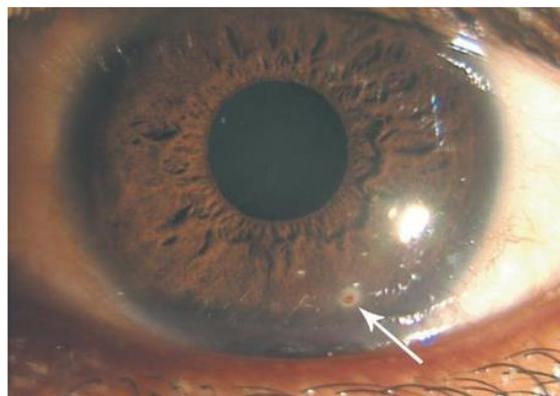


Figure 1: Metallic foreign body on the cornea

Posterior segment findings were documented in **18%** of cases, including commotio retinae (**8%**), papilledema (**6%**), and retinal detachment (**4%**). These findings were more frequently observed in patients with moderate to severe head injury.



Figure 2: Traumatic Hyphema

Neuro-ophthalmic manifestations were present in **14%** of patients and included cranial nerve palsies (**8%**), traumatic optic neuropathy (**4%**), and abnormal pupillary reactions (**2%**). These findings were predominantly associated with severe head injury.

Correlation of Ocular Manifestations with Severity of Head Injury

A clear correlation was observed between the severity of head injury and the pattern of ocular involvement.

- In **mild head injury**, ocular findings were predominantly limited to adnexal and anterior segment lesions.
- In **moderate head injury**, posterior segment involvement was more frequent.
- In **severe head injury**, neuro-ophthalmic manifestations predominated.

The association between ocular manifestations and GCS was statistically significant ($p < 0.05$). Patients with ocular involvement demonstrated a higher likelihood of poor neurological outcome and prolonged hospital stay.

Table 4: Correlation of ocular manifestations with Glasgow Coma Scale (GCS)

| Ocular involvement | Mild (GCS 13–15) | Moderate (GCS 9–12) | Severe (GCS ≤ 8) | Total (%) |
|----------------------------|------------------|---------------------|------------------------|-----------|
| Adnexal (ecchymosis, lid) | 24 | 12 | 8 | 44 |
| Anterior segment | 20 | 8 | 4 | 32 |
| Posterior segment | 4 | 10 | 4 | 18 |
| Neuro-ophthalmic | 2 | 4 | 8 | 14 |
| Total with ocular findings | 50 | 34 | 24 | 68 |

4. Discussion

The present study demonstrates a high prevalence of ocular manifestations among patients with head injury, with 68% of the cohort exhibiting one or more ocular findings. This observation is consistent with existing literature, which reports ocular involvement in approximately 25–90% of patients with traumatic brain injury (TBI) [6–9]. The considerable variability in reported prevalence across studies likely reflects heterogeneity in study populations, mechanisms of injury, severity of trauma, and the extent of ophthalmic evaluation performed.

Adnexal injuries constituted the most frequently encountered ocular manifestations in the present study, with periorbital ecchymosis and subconjunctival haemorrhage predominating. Similar patterns have been described by Sharma et al. [17] and Pattnaik et al. [18], who reported adnexal involvement in 28–44% of head injury cases. Although these findings are generally benign and self-limiting, they serve as readily identifiable clinical markers of craniofacial trauma and may prompt further evaluation for associated ocular and intracranial injuries.

Anterior segment injuries, including corneal abrasions and Hyphema, were also observed, in agreement with earlier reports by Singh et al. [6] and Kulkarni et al. [19]. Among these, Hyphema is of particular clinical importance, as it carries a risk of secondary complications such as raised intraocular pressure, corneal blood staining, and long-term visual impairment. Early recognition and appropriate management of such injuries are therefore essential to prevent avoidable visual morbidity.

Posterior segment manifestations, although less common, were significantly associated with moderate to severe head injury. Findings such as commotio retinae, papilledema, and retinal detachment were more frequently observed in patients with lower Glasgow Coma Scale (GCS) scores. These observations are consistent with reports by Malik et al. [20] and Shah et al. [21], who emphasized that posterior segment involvement often reflects high-energy trauma and is associated with poorer visual and neurological outcomes.

Neuro-ophthalmic manifestations represented the most severe spectrum of ocular involvement in the present study. Cranial nerve palsies and traumatic optic neuropathy (TON) were predominantly observed in patients with severe head injury. TON has been reported to occur in approximately 1–7% of head injury cases and is frequently associated with limited visual recovery despite intervention [22]. Cranial nerve

palsies involving the third, fourth, and sixth cranial nerves may indicate brainstem or cavernous sinus involvement and were found to correlate with lower GCS scores in this study, consistent with observations by Odebode et al. [7].

The statistically significant association between ocular manifestations and neurological severity underscores the value of ocular findings as surrogate clinical markers of intracranial injury. Previous studies, including those by Maheshwari et al. [23], have highlighted the prognostic relevance of ocular signs in predicting the severity and outcome of head injury. These findings support the integration of routine ophthalmic assessment into standard trauma evaluation protocols, particularly in tertiary care settings managing high volumes of head injury patients.

5. Strengths

The strengths of this study include its prospective design, systematic and comprehensive ophthalmic evaluation, and correlation of ocular findings with neurological severity using a standardized and widely accepted scoring system.

6. Limitations

The limitations of the present study include its single-centre design, relatively small sample size, and absence of long-term follow-up to assess visual and functional outcomes. Future multicentric studies with larger cohorts and longitudinal follow-up are warranted to further elucidate the prognostic implications of ocular manifestations in head injury.

7. Conclusion

Ocular manifestations are common in patients with head injury and show a significant correlation with neurological severity as assessed by the Glasgow Coma Scale. Early and systematic ophthalmic evaluation should be incorporated into routine trauma care to enable timely diagnosis, appropriate intervention, and prevention of long-term visual morbidity.

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None.

Conflict of Interest

None declared.

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