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Clinical Spectrum and Prognostic Evaluation of Ocular Trauma Using Ocular Trauma Score in a Tertiary Care Hospital of Uttarakhand: A Cross-Sectional Study.

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Abstract

Background:
Ocular trauma is an important cause of preventable monocular blindness and visual morbidity, particularly among young individuals in developing countries. Early prognostic assessment is essential for appropriate management and prediction of the final visual outcome. The Ocular Trauma Score (OTS) is a standardized scoring system used to estimate visual prognosis following ocular injury.

Aim:
To evaluate the clinical spectrum of ocular trauma and assess the prognostic significance of the Ocular Trauma Score in patients presenting to a tertiary care hospital in Uttarakhand.

Materials and Methods:
This hospital-based cross-sectional observational study included 110 patients presenting with ocular trauma at a tertiary care center in Uttarakhand. Detailed demographic profile, mode and place of injury, clinical examination findings, and injury classification based on the Birmingham Eye Trauma Terminology System were recorded. Ocular Trauma Score was calculated for each patient. Statistical analysis was performed using the chi-square test, and a p-value <0.05 was considered statistically significant.

Results:
Among 110 participants, males constituted the majority of cases (89.1%), with young adults aged 21–40 years being the most commonly affected age group. Closed globe injuries accounted for 80.9% cases, while open globe injuries constituted 19.1%. Road traffic accidents were the most common mode of injury, followed by falls and occupational trauma. OTS Category 3 was the predominant category (62.7%). Significant association was observed between OTS category, type of injury, and visual outcome ($p < 0.001$), with lower OTS categories associated with severe trauma and poorer prognosis.

Conclusion and Recommendation:
Ocular trauma predominantly affects young males and commonly results from road traffic accidents. Ocular Trauma Score is a reliable prognostic tool for predicting injury severity and visual outcome. Routine use of OTS should be incorporated in ocular trauma evaluation, along with strengthening preventive strategies such as road safety awareness and protective eye measures.

Keywords: *Ocular trauma, Ocular Trauma Score, Open globe injury, Closed globe injury, Visual prognosis, Birmingham Eye Trauma Terminology classification.*
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Introduction

Ocular trauma is a major cause of preventable visual impairment and monocular blindness worldwide.[3,11,28] It accounts for a substantial proportion of ophthalmic emergencies and predominantly affects young adults in their productive years, thereby producing significant socioeconomic consequences.[10,13,21]

Globally, millions of ocular injuries occur annually, with many resulting in permanent visual disability.[3,28] The burden is disproportionately higher in developing countries because of occupational hazards, agricultural activities, lack of protective eyewear, and increasing road traffic accidents.[12,19,30] Young males are the most commonly affected demographic group due to greater exposure to outdoor activities, manual labor, and vehicular travel.[7,14,24]

The epidemiological pattern of ocular trauma varies depending on geographical, occupational, and socioeconomic factors.[6,15,26] In hilly regions such as Uttarakhand, difficult terrain and delayed access to tertiary care facilities may further worsen visual outcomes.[7]

To standardize ocular trauma terminology, the Birmingham Eye Trauma Terminology System (BETT) was introduced and remains widely accepted for the classification of open and closed globe injuries.[2,4,25] However, classification alone does not adequately predict prognosis.

The Ocular Trauma Score (OTS), developed by Kuhn et al., is a reliable prognostic tool based on presenting visual acuity and associated ocular findings such as globe rupture, retinal detachment, endophthalmitis, perforating injury, and relative afferent pupillary defect.[1] The OTS has been validated in several studies and has shown excellent correlation with final visual outcome.[16,17,18]

The use of OTS assists clinicians in:

- Predicting visual prognosis
- Guiding management decisions
- Prioritizing surgical intervention
- Counseling patients and relatives regarding expected visual outcomes

Despite its proven utility, OTS remains underutilized in routine trauma assessment, especially in regional studies from developing countries.[5,8]

The present study was therefore undertaken to evaluate the clinical spectrum of ocular trauma in a tertiary care hospital in Uttarakhand and to assess the prognostic significance of OTS in predicting injury severity and visual outcome.

Materials and Methods

Study Design

This hospital-based observational study was conducted at a tertiary care center in Uttarakhand.

Study Population

The sample size was calculated using the standard formula for cross-sectional studies:

$$n = Z^2 \times p \times q / d^2$$

Where:

- n = required sample size
- Z = 1.96 at 95% confidence interval
- p = expected prevalence of ocular trauma (taken as 8% from previous regional studies)
- q = 1 – p
- d = allowable error of 5%

The calculated minimum sample size was approximately 113 participants. Considering the feasibility and availability of eligible patients during the study period, **110 patients were finally enrolled and included for analysis.**

Inclusion Criteria

- Patients presenting with ocular trauma during the study period
- Patients willing to participate

Exclusion Criteria

- Patients with previous ocular pathology affecting visual acuity
- Patients lost to follow-up

Ethical Considerations and Informed Consent

Prior to commencement of the study, approval was obtained from the Institutional Ethics Committee of the tertiary care teaching hospital. All participants fulfilling the inclusion criteria were informed in detail regarding the nature, purpose, and objectives of the study.

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Written informed consent was obtained from all adult participants before enrollment. In cases involving paediatric patients, informed consent was obtained from parents or legal guardians. Participants were assured that confidentiality of personal and clinical information would be strictly maintained, and participation in the study was entirely voluntary. Refusal to participate did not affect the standard of treatment provided.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human participants.

Clinical Evaluation

Detailed demographic and clinical history, including age, sex, type of trauma, place of injury, mode of injury, and distance travelled to the hospital, was recorded.

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Comprehensive ophthalmic examination included:

- Visual acuity assessment
- Slit-lamp examination
- Intraocular pressure measurement
- Fundus examination

B-scan ultrasonography was performed in cases with media opacity preventing posterior segment visualization.

Classification of Injury

Ocular injuries were classified according to the Birmingham Eye Trauma Terminology System (BETT).[2,4,25]

Ocular Trauma Score

OTS was calculated according to the scoring system proposed by Kuhn et al.[1] based on:

- Initial visual acuity
- Globe rupture
- Endophthalmitis
- Retinal detachment
- Relative afferent pupillary defect
- Perforating injury

Statistical Analysis

Data were analyzed using the chi-square test, and a p-value <0.05 was considered statistically significant.

Results

Distribution of Open and Closed Globe Injuries

Closed globe injuries constituted the majority of cases (80.9%), while open globe injuries accounted for 19.1%. Similar predominance of closed globe trauma has been reported in previous epidemiological studies.[6,8,30]

Table 1. Distribution of Open Globe and Closed Globe Injuries among Study Participants

Type of Injury	Number (%)
Open Globe	21 (19.1%)
Closed Globe	89 (80.9%)

Sex Distribution

Males predominated in both open and closed globe injuries, consistent with previously published literature.[7,10,13,24]

Table 2. Sex Distribution according to Type of Ocular Injury

Sex	Open Globe	Closed Globe
Male	20	78
Female	1	11

$\chi^2 = 1.01$, $p = 0.315$

Age Distribution

Young and middle-aged adults formed the majority of the study population, similar to findings reported in other epidemiological studies.[12,14,27]

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Table 3. Age Distribution according to Type of Ocular Injury

Age Group	Open Globe	Closed Globe
<10	6	8
11–20	1	13
21–30	5	23
31–40	5	11
41–50	2	18
>50	2	16

$\chi^2 = 9.78$, $p = 0.082$

Type of Trauma

Polytrauma showed a significant association with closed globe injuries.

Table 4. Distribution of Isolated Trauma and Polytrauma

Type	Open Globe	Closed Globe
Isolated	18	21
Polytrauma	3	68

$\chi^2 = 28.7$, $p < 0.001$

Place of Injury

Road traffic accidents represented the most common injury setting, reflecting trends observed in developing countries.[12,19,26]

Table 5. Place of Injury according to Type of Injury

Place	Open Globe	Closed Globe
Home	10	16
RTA	5	57
Workplace	6	16

$\chi^2 = 12.1$, $p = 0.002$

Mode of Injury

Road traffic accidents were the predominant mode of injury, followed by falls and occupational trauma. Similar findings have been reported by several previous studies.[6,21,30]

Table 6. Mode of Injury according to Type of Ocular Trauma

Mode	Open Globe	Closed Globe
Chemical	0	4
Thermal	3	2
Fall	4	17
RTA	11	62

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Mode	Open Globe	Closed Globe
Metal	3	1

$\chi^2 = 15.9$, $p = 0.026$

OTS Category Distribution

OTS Category 3 was the most common category, suggesting moderate-severity trauma with reasonable prognosis.

Table 7. Distribution of Ocular Trauma Score Categories

OTS Category	Number	Percentage
Category 1	3	2.7%
Category 2	26	23.6%
Category 3	69	62.7%
Category 4	6	5.5%
Category 5	6	5.5%

Ocular Trauma Score Versus Type of Injury

Lower OTS categories were significantly associated with open globe injuries and severe ocular damage.[1,16,17]

Table 8. Association between Ocular Trauma Score and Type of Injury

OTS	Open Globe	Closed Globe
Category 1	3	0
Category 2	14	12
Category 3	4	65
Category 4	0	6
Category 5	0	6

$\chi^2 = 52.6$, $p < 0.001$

OTS Versus Visual Outcome

A highly significant association was observed between OTS category and visual outcome, consistent with previous validation studies.[1,16,17,18]

Table 9. Association between Ocular Trauma Score and Visual Outcome

OTS	Severe	Moderate	Good
Category 1	3	0	0
Category 2	18	6	2
Category 3	12	34	23
Category 4	0	2	4
Category 5	0	0	6

$\chi^2 = 68.4$, $p < 0.001$

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Discussion

The present study was conducted at a tertiary care hospital in Uttarakhand and reflects the epidemiological profile and clinical spectrum of ocular trauma seen in this geographic region. Since Uttarakhand has a mixed urban-rural population with difficult hilly terrain and delayed healthcare accessibility, the findings may be generalized to similar tertiary care centers in North India and other developing regions with comparable healthcare infrastructure. However, the findings may not be directly applicable to highly urbanized populations or specialized trauma centers with different demographic and injury patterns.

The present study provides a comprehensive evaluation of ocular trauma and emphasizes the prognostic significance of the Ocular Trauma Score.

Closed globe injuries constituted the majority of cases (80.9%), consistent with previous studies conducted in India and abroad.[6,8,19] Blunt trauma due to road traffic accidents and falls represented the predominant mechanism of injury. A marked male predominance was observed, similar to findings reported by MacEwen, Sharma et al., and May et al.[7,10,13] Young adults formed the majority of affected individuals due to greater occupational and outdoor exposure.[12,24]

Road traffic accidents emerged as the most common mode of injury. Similar observations have been reported in studies from India, China, and Egypt.[6,12,30] This highlights the growing burden of vehicular trauma and the importance of strict implementation of road safety measures.

The study demonstrated statistically significant associations between the type of injury and factors such as place and mode of injury, suggesting that environmental and behavioral factors play a crucial role in determining injury severity.[20,22]

The most important finding of the present study was the strong correlation between the OTS category and visual outcome. Lower OTS categories were associated with severe visual impairment and posterior segment involvement. These findings are in agreement with the original OTS validation studies by Kuhn et al.[1] as well as later studies by Rahman et al. and Fujikawa et al.[16,17]

Posterior segment involvement was significantly more common in lower OTS categories. Vitreous hemorrhage and retinal detachment are known predictors of poor visual prognosis and often require complex vitreoretinal surgical intervention.[9,18]

The predominance of OTS Category 3 suggests that many patients present with moderate ocular trauma where timely intervention can substantially improve visual outcome. The results reinforce the usefulness of OTS as a reliable and practical prognostic tool in emergency ophthalmic settings.[1,17,25]

The study also highlights regional challenges faced in Uttarakhand, including delayed presentation due to difficult terrain and limited accessibility to tertiary ophthalmic care.[7] Strengthening referral systems and increasing awareness regarding protective eyewear may significantly reduce ocular morbidity.[23,29]

Conclusion

In the present study, closed globe injuries constituted the majority of ocular trauma cases (80.9%), while open globe injuries accounted for 19.1% cases. Road traffic accidents were identified as the most common mode of injury. Ocular Trauma Score Category 3 was the most frequent category among study participants. A statistically significant association was observed between OTS category, type of injury, and final visual outcome ($p < 0.001$). Lower OTS categories were associated with more severe ocular damage and poorer prognosis. The findings of this study demonstrate that routine application of OTS provides valuable prognostic information and can assist clinicians in management planning and patient counselling in ocular trauma cases.

Limitations

The present study had certain limitations:

- The study was conducted in a single tertiary care centre, limiting wider population representation.
- Sample size was relatively small (110 patients).
- Long-term visual outcome assessment was limited.
- Referral bias may have occurred as severe trauma cases are more likely to present to tertiary hospitals.
- Patients lost prior to enrollment could not be evaluated

Recommendations

Based on the findings of the present study, the following recommendations are suggested:

- Routine use of the Ocular Trauma Score should be incorporated in ocular trauma evaluation.
- Road safety awareness programs should be strengthened to reduce trauma related to road traffic accidents.
- Use of protective eyewear should be encouraged in high-risk occupations.
- Early referral systems should be strengthened in rural and hilly areas of Uttarakhand.

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- Larger multicentric studies should be conducted for a better epidemiological understanding of ocular trauma in India

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The present study did not receive any external funding or financial support from any organization.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study.

List of Abbreviations

Abbreviation	Full Form
OTS	Ocular Trauma Score
BETT	Birmingham Eye Trauma Terminology
RTA	Road Traffic Accident
RAPD	Relative Afferent Pupillary Defect
IOP	Intraocular Pressure
SD	Standard Deviation
χ^2	Chi-Square Test
VA	Visual Acuity

Author contributions:

Dr Saurabh Rawat – Data Collection, Data Analysis, Manuscript Drafting, and Corresponding
Dr Vatsala Vats – Concept Design, Data Analysis, Manuscript Review, Final approval
Dr Monika Jain – Data Analysis, Manuscript Drafting, Manuscript Review, Final approval
Dr Tarannum Shakeel – Data Analysis, Manuscript Drafting, Manuscript Review, Final approval

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