

Original Research Article

Pattern and Clinical Profile of Ocular Trauma Presenting to a Tertiary-Care Hospital: A Retrospective Observational Study

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ABSTRACT

Background: Ocular trauma remains an important and potentially preventable cause of visual morbidity. Its clinical spectrum ranges from relatively limited closed-globe injury to open-globe trauma with profound visual loss, making early injury classification and prognostic assessment clinically relevant.

Objective: To describe the demographic and clinical pattern of ocular trauma and evaluate the relationship of injury type and Ocular Trauma Score (OTS) category with recorded visual outcome.

Methods: This retrospective observational study analysed 44 patient-level records of mechanical ocular trauma. Age, sex, laterality, injury type and subtype, zone, mechanism, presenting visual acuity, OTS category, anterior and posterior segment involvement, surgery, final visual acuity, and outcome were evaluated. Three bilateral cases were retained as single patient-level observations because only one composite trauma record was available per patient. Categorical variables were summarised as frequencies and percentages. Sparse contingency tables were assessed using Fisher-Freeman-Halton exact tests with Monte Carlo estimation; OTS and ordered outcome were examined using Spearman rank correlation.

Results: Mean age was 38.09 ± 13.37 years and 35 (79.5%) patients were male. Closed-globe injury (CGI) occurred in 30 (68.2%) and open-globe injury (OGI) in 14 (31.8%). Industrial trauma was the leading mechanism (12, 27.3%), followed by road traffic accidents (8, 18.2%). OGI patients were younger than CGI patients (median 28.0 versus 44.5 years; Mann-Whitney $U=342$, $p<0.001$). Good, moderate, and poor outcomes were recorded in 14 (31.8%), 20 (45.5%), and 10 (22.7%), respectively. Poor outcome occurred in 10/14 (71.4%) OGI patients and in none of the 30 CGI patients ($p<0.001$). OTS category correlated strongly with ordered outcome (Spearman $\rho=0.880$, $p<0.001$).

Conclusion: Ocular trauma in this series predominantly affected males, with closed-globe injuries being more common overall. Industrial injury and road traffic accidents were prominent mechanisms. Open-globe injury was concentrated in younger patients and was associated with substantially poorer visual outcome. OTS showed a strong graded relationship with outcome and may support early prognostic counselling when interpreted alongside the clinical examination.

Keywords: Ocular Trauma, Closed-Globe Injury, Open-Globe Injury, Ocular Trauma Score, Visual Outcome, Eye Injury, India.

INTRODUCTION

Mechanical ocular trauma encompasses a heterogeneous group of injuries, and meaningful comparison between centres depends on consistent terminology. The

development of standardised ocular-trauma nomenclature provided a common framework for distinguishing open- and closed-globe injury and for describing clinically important subtypes.^[1] A complementary mechanical

injury classification subsequently incorporated type, presenting visual acuity, pupillary response, and zone as prognostically relevant variables.^[2]

The Birmingham Eye Trauma Terminology (BETT) system further consolidated the language used for mechanical globe trauma and remains widely used in clinical reporting.^[3] Prognosis, however, requires more than terminology alone. The Ocular Trauma Score (OTS) was introduced as a practical severity system intended to translate early clinical findings into an estimate of likely final visual acuity.^[4]

The epidemiology of ocular trauma varies considerably by occupation, transport exposure, domestic environment, age, and access to eye-care services. In a teaching-hospital study from northern India, men constituted nearly three-quarters of ocular-trauma patients, and the authors emphasised the importance of preventive strategies at work, during travel, and in recreational settings.^[5] A rural western Indian series similarly reported male predominance and a greater proportion of closed-globe than open-globe injuries, with meaningful visual recovery after treatment in many patients.^[6]

More recent South Indian hospital data continue to show the same broad pattern: young men remain disproportionately affected, closed-globe injuries are common, and open-globe trauma carries a poorer prognosis.^[7] Yet local distributions of industrial injury, road traffic accidents, assault, domestic trauma, falls, and agricultural injury can differ substantially. Describing the pattern seen at an individual tertiary-care service therefore has practical value for preventive counselling, triage, and resource planning.

The present study was undertaken to characterise the demographic profile, injury pattern, presenting and final visual status, and recorded outcomes among patients with ocular trauma. A secondary objective was to examine whether injury type and OTS category were associated with the final outcome classification.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based retrospective observational study was undertaken in the Department of Ophthalmology at KVG Medical College Sullia, Dakshina Kannada for a period of 10 months.

The analysed series comprised 44 patient-level records of mechanical ocular trauma.

Study Population

Records were included in the analysis when the core variables required for the study were complete: age, sex, eye affected, injury type and subtype, zone, mechanism, presenting visual acuity, OTS category, ocular segment involvement, surgical status, final visual acuity, and outcome. All 44 records contained these variables. The exact sampling frame and case-selection method were not specified, and no claim of random or consecutive sampling was made.

Injury Variables and Outcome Assessment

Recorded injury type was categorised as closed-globe injury (CGI) or open-globe injury (OGI). Subtypes comprised contusion, lamellar laceration, penetrating injury, perforating injury, globe rupture, and intraocular foreign body (IOFB). Mechanisms were recorded as industrial injury, road traffic accident (RTA), domestic injury, assault, fall, sports-related injury, or agricultural injury. Zone and OTS category were analysed exactly as recorded. Presenting and final visual acuity were retained in their documented Snellen or low-vision notation (hand movements, perception of light, or no perception of light). The three-level outcome classification (good, moderate, or poor) was also retained without reclassification.

Unit of Analysis

The analysis was performed at patient level. Three records were marked as bilateral, but each contained only one composite set of presenting visual acuity, OTS, injury characteristics, final visual acuity, and outcome. These patients were therefore not duplicated as separate eye-level observations.

Data Quality and Statistical Analysis

The 44 data rows were checked for completeness, duplicate serial numbers, range errors, inconsistent category spelling, and internal formatting artifacts. No clinical value required imputation or alteration. Continuous data are summarised using mean $\pm$ standard deviation and median with interquartile range where informative; categorical data are presented as number and percentage. Age distributions between CGI and OGI were compared using the Mann-Whitney U test. Because several contingency tables contained

small or zero cell counts, associations of injury type with outcome, mechanism with injury type, and OTS category with outcome were evaluated using Fisher-Freeman-Halton exact testing with Monte Carlo estimation. Outcome was ordered as poor, moderate, and good for Spearman correlation with OTS. A two-sided p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining institutional ethical clearance and in accordance with accepted ethical principles for research involving human participants. Patient

confidentiality and anonymity were maintained throughout the study. No research-specific therapeutic intervention was introduced as part of this record-based analysis.

RESULTS

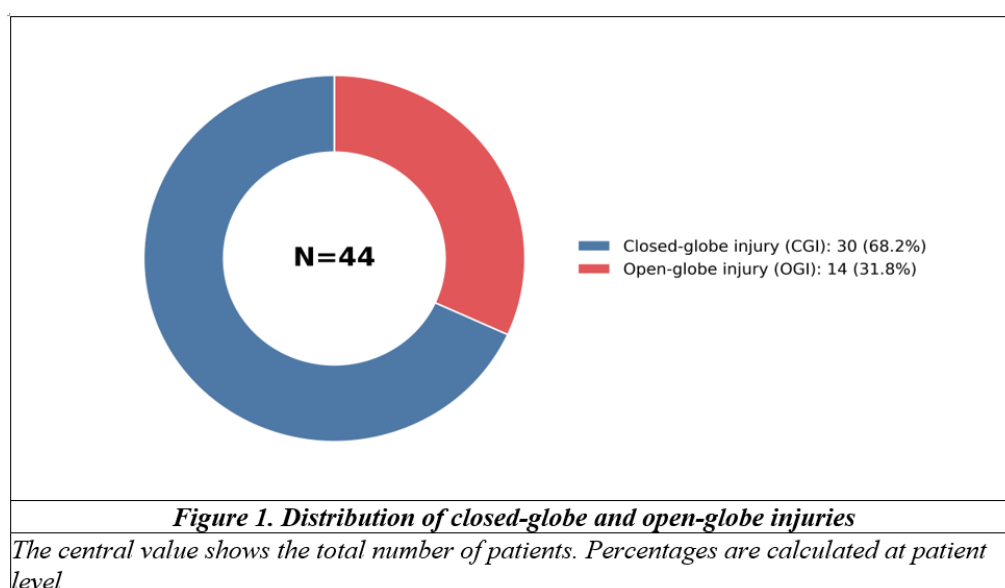
All 44 patient records were complete for the variables used in the analysis and were retained. Mean age was 38.09 ± 13.37 years (range 16-67 years), with a median of 36.5 years (IQR 27.75-48.25). Men constituted 35 (79.5%) of the cohort. Right-eye involvement was recorded in 21 (47.7%), left-eye involvement in 20 (45.5%), and bilateral trauma in 3 (6.8%) (Table 1).

Characteristic	Value
Age (years), mean ± SD	38.09 ± 13.37
Age (years), median (IQR)	36.5 (27.75-48.25)
Male	35 (79.5%)
Female	9 (20.5%)
Right eye	21 (47.7%)
Left eye	20 (45.5%)
Bilateral	3 (6.8%)
Closed-globe injury	30 (68.2%)
Open-globe injury	14 (31.8%)
Posterior-segment involvement	14 (31.8%)
Surgery performed	14 (31.8%)

Table 1. Demographic and overall clinical characteristics of patients with ocular trauma (N=44)
SD: standard deviation; IQR: interquartile range

CGI was present in 30 (68.2%) and OGI in 14 (31.8%) patients (Figure 1). The OGI group was substantially younger, with median age 28.0 years (IQR 22.5-32.75),

compared with 44.5 years (IQR 33.25-51.75) in the CGI group (Mann-Whitney U=342, p<0.001).



Contusion was the most frequent subtype, affecting 26 (59.1%) patients,

followed by penetrating injury in 6 (13.6%). Industrial trauma was the leading mechanism

(12, 27.3%), followed by RTA (8, 18.2%), domestic injury (7, 15.9%), and assault (6, 13.6%). Mechanism differed significantly

between CGI and OGI (Fisher-Freeman-Halton $p=0.007$) (Table 2, Figure 2).

Variable	Category	n (%)
Subtype	Contusion	26 (59.1%)
Subtype	Lamellar Laceration	4 (9.1%)
Subtype	Penetrating	6 (13.6%)
Subtype	Rupture	3 (6.8%)
Subtype	IOFB	3 (6.8%)
Subtype	Perforating	2 (4.5%)
Mechanism	Industrial	12 (27.3%)
Mechanism	RTA	8 (18.2%)
Mechanism	Domestic	7 (15.9%)
Mechanism	Assault	6 (13.6%)
Mechanism	Fall	6 (13.6%)
Mechanism	Sports	3 (6.8%)
Mechanism	Agricultural	2 (4.5%)

Table 2. Injury subtype and mechanism in the study cohort

IOFB: intraocular foreign body; RTA: road traffic accident

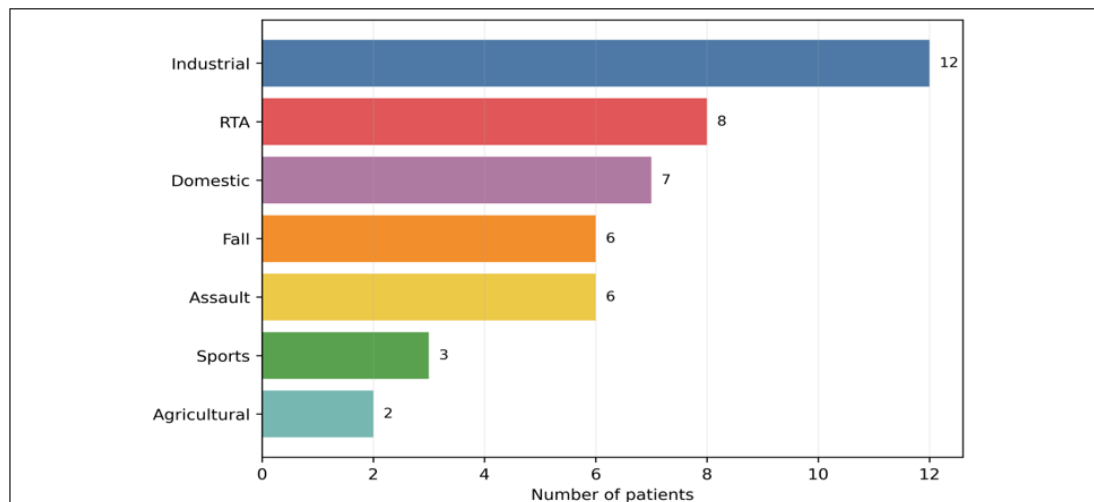


Figure 2. Distribution of ocular-trauma mechanisms

Bars show the number of patients for each recorded mechanism

Presenting visual acuity ranged from 6/12 to no perception of light. OTS categories were distributed from 1 to 5, with category 4 being the most frequent. Final visual acuity and the recorded three-level outcome

classification are summarised in Table 3. Overall, 14 (31.8%) patients had a good outcome, 20 (45.5%) had a moderate outcome, and 10 (22.7%) had a poor outcome.

Domain	Category	n (%)
Presenting VA	6/12	7 (15.9%)
Presenting VA	6/18	7 (15.9%)
Presenting VA	6/24	7 (15.9%)
Presenting VA	6/36	7 (15.9%)
Presenting VA	6/60	2 (4.5%)
Presenting VA	HM	6 (13.6%)
Presenting VA	PL	6 (13.6%)
Presenting VA	NPL	2 (4.5%)
OTS	1	8 (18.2%)

OTS	2	6 (13.6%)
OTS	3	9 (20.5%)
OTS	4	14 (31.8%)
OTS	5	7 (15.9%)
Final VA	6/9	7 (15.9%)
Final VA	6/12	7 (15.9%)
Final VA	6/18	8 (18.2%)
Final VA	6/24	6 (13.6%)
Final VA	6/36	2 (4.5%)
Final VA	6/60	4 (9.1%)
Final VA	3/60	2 (4.5%)
Final VA	PL	3 (6.8%)
Final VA	NPL	5 (11.4%)
Outcome	Good	14 (31.8%)
Outcome	Moderate	20 (45.5%)
Outcome	Poor	10 (22.7%)

Table 3. Presenting visual acuity, OTS category, final visual acuity and recorded outcome

VA: visual acuity; OTS: Ocular Trauma Score; HM: hand movements; PL: perception of light; NPL: no perception of light

Outcome differed markedly by injury type (Table 4 and Figure 3). Among CGI patients, 14/30 (46.7%) had a good outcome and 16/30 (53.3%) had a moderate outcome; no poor outcome was recorded. Among OGI patients, 4/14 (28.6%) had a moderate

outcome and 10/14 (71.4%) had a poor outcome, with no good outcome. The association between injury type and outcome was significant (Fisher-Freeman-Halton $p < 0.001$).

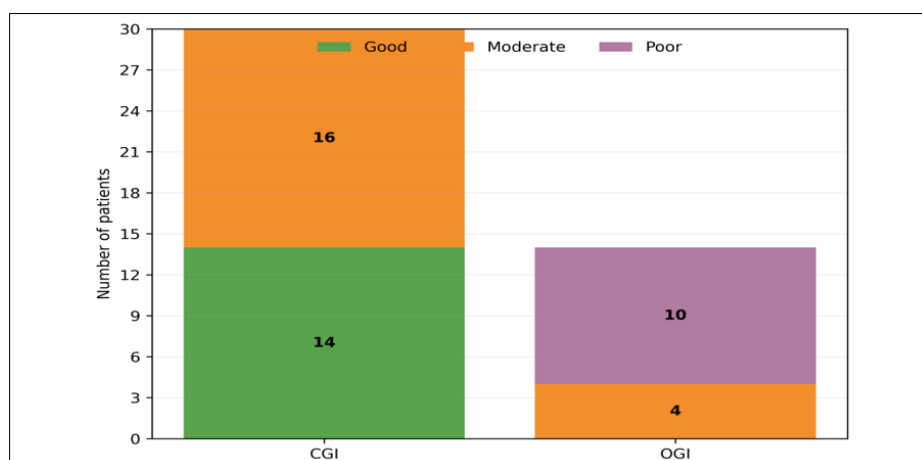


Figure 3. Recorded visual outcome according to injury type

Stacked bars show patient counts within closed-globe injury (CGI) and open-globe injury (OGI)

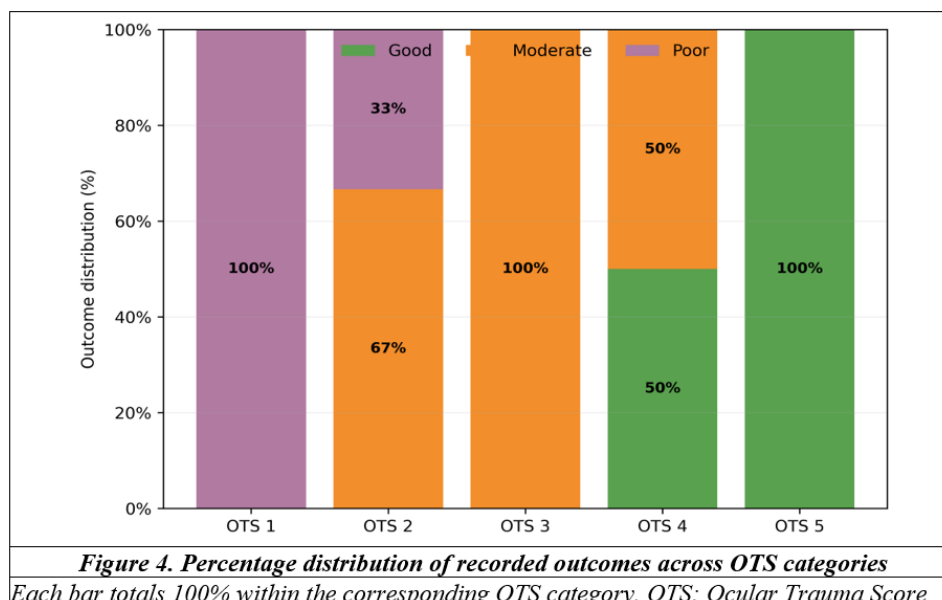
Grouping	Category	Good	Moderate	Poor
Injury type	CGI	14	16	0
Injury type	OGI	0	4	10
OTS category	1	0	0	8
OTS category	2	0	4	2
OTS category	3	0	9	0
OTS category	4	7	7	0
OTS category	5	7	0	0

Table 4. Recorded outcome according to injury type and OTS category

Injury type vs outcome: Fisher-Freeman-Halton $p < 0.001$. OTS category vs outcome: Fisher-Freeman-Halton $p < 0.001$

A clear graded relationship was also observed between OTS and outcome. All eight patients in OTS category 1 had a poor outcome, whereas all seven patients in category 5 had a good outcome. Category 3 was uniformly associated with a moderate outcome, while

category 4 was split between good and moderate outcomes. The OTS-outcome association was significant ($p < 0.001$), and OTS correlated strongly with ordered outcome (Spearman $\rho = 0.880$, $p < 0.001$) (Figure 4).



DISCUSSION

The present study describes a compact but clinically coherent tertiary-care ocular-trauma series. Four findings stand out. First, ocular trauma predominantly affected men. Second, CGI was more common than OGI. Third, industrial exposure and road traffic accidents together accounted for a large share of injuries. Most importantly, OGI was associated with substantially worse recorded outcomes, while increasing OTS category showed a strong graded relationship with more favourable outcome.

Male predominance is one of the most consistent findings across Indian ocular-trauma studies. In a prospective study of maxillofacial trauma from Pondicherry, men constituted more than 90% of patients, with road traffic accidents being the dominant mechanism.^[8] The proportion of men in the present study was similarly high at 79.5%. This pattern is clinically plausible in the Indian setting, where occupational exposure, road travel, manual work, and certain sports or assault-related risks remain disproportionately concentrated among males.

Industrial injury was the single largest mechanism in this cohort. Earlier Indian work on occupational open-globe injury showed that workplace trauma commonly affected young men and was frequently associated with

severe injury and poor visual outcome, leading the authors to emphasise protective eyewear and workplace safety.^[9] In the present series, industrial trauma accounted for 27.3% of all cases and included both closed- and open-globe injuries. This reinforces a preventable component of the local burden, even though information on actual protective-eyewear use was not available.

The prognosis of OGI was distinctly worse than that of CGI. This accords with Indian surgical series. Rao and colleagues reported that presenting visual acuity, zone, hyphema, retinal detachment, vitreous haemorrhage, and other markers of injury severity influenced final vision after open-globe injury.^[10] In the Moradabad Ocular Trauma Study, poor presenting acuity and other severe clinical features were among the strongest predictors of vision loss after OGI.^[11] Our data are simpler and do not contain all of these prognostic variables, but the same broad clinical gradient is visible: none of the CGI patients had a poor recorded outcome, whereas 71.4% of OGI patients did.

The OTS findings merit particular attention. A Central Indian IGATES report found that OTS remained a largely effective tool for counselling patients with OGI, although the observed outcome distribution did not perfectly reproduce the original

international system.^[12] A much larger rural West Indian IGATES cohort likewise identified poor initial visual acuity, posterior injury location, wound characteristics, and infection as important determinants of worse outcome.^[13] These studies highlight why a trauma score should be regarded as structured prognostic support rather than a substitute for detailed ocular examination.

The closed-globe predominance in our cohort is also consistent with earlier community-oriented Indian observations. In a historical cohort from tribal western India, closed-globe injuries were substantially more frequent than open-globe injuries and tended to show better visual results after management.^[14] Our CGI proportion of 68.2% is remarkably similar to the 68.3% reported in another rural western Indian clinical series cited earlier.^[6] This resemblance should not be overinterpreted because the mechanisms, referral pathways, case mix, and study periods differ, but it supports the plausibility of a CGI-dominant tertiary-care pattern.

The strong OTS-outcome relationship in the present study is directionally consistent with recent Indian validation work. Noble and colleagues reported significant correlation between OTS-predicted and final visual acuity in an Indian cohort containing both open- and closed-globe injuries.^[15] Here, the ordinal correlation between OTS category and outcome was 0.880. However, the highly structured separation across categories, especially the uniform poor outcome in OTS 1 and uniform good outcome in OTS 5, should be interpreted cautiously in a sample of only 44 patients.

Mechanism also differed between injury types. Domestic injuries, falls, and sports injuries occurred only among CGI records, whereas agricultural trauma occurred only among OGI records; industrial injury, RTA, and assault contributed to both. These distributions are clinically meaningful for prevention. Workplace eye protection, road-safety measures, early referral after penetrating injury, and targeted health education in agricultural and domestic settings remain practical interventions. Yet causal interpretation is not possible because exposure intensity, protective-equipment use, alcohol use, delay to presentation, and socioeconomic characteristics were not recorded.

Strengths and Limitations

Strengths include complete patient-level data for the analysed variables, explicit distinction between open- and closed-globe injury, inclusion of presenting and final visual acuity, and availability of OTS and outcome categories. Statistical testing was selected to accommodate sparse contingency tables rather than relying on asymptotic chi-square assumptions. Bilateral cases were also handled conservatively at patient level rather than artificially doubling the number of observations.

Several limitations are acknowledged. The sample is modest and derived from a single tertiary-care setting, limiting generalisability. The study period, exact sampling frame, detailed examination protocol, follow-up interval for final visual acuity, and prespecified thresholds underlying the good/moderate/poor outcome labels were not available for further specification. Three bilateral injuries were represented by one composite patient-level trauma record, preventing eye-specific analysis. Anterior-segment involvement was recorded in every patient, while posterior-segment involvement and surgery were perfectly aligned with OGI status in this series; these tightly coupled variables limit independent inferential interpretation. Finally, OTS categories rather than the individual raw-score components were available, so the score could not be independently reconstructed or recalibrated.

CONCLUSION

In this series of 44 patients with ocular trauma, men constituted the majority and closed-globe injury was more common than open-globe injury. Industrial trauma and road traffic accidents were prominent mechanisms. Open-globe injury occurred in a younger subgroup and was associated with substantially poorer recorded visual outcomes. OTS category showed a strong graded relationship with outcome, supporting its practical prognostic value when used alongside a complete ocular examination. The observed concentration of preventable mechanisms also reinforces the importance of workplace eye protection, road-safety measures, and timely referral for severe ocular injury.

Source of Funding

Nil.

Conflict of Interest

None declared.

REFERENCES

1. Kuhn F, Morris R, Witherspoon CD, Heimann K, Jeffers JB, Treister G. A standardized classification of ocular trauma. *Ophthalmology* 1996;103(2):240-3. doi:10.1016/S0161-6420(96)30710-0.
2. Pieramici DJ, Sternberg P Jr, Aaberg TM Sr, Bridges WZ Jr, Capone A Jr, Cardillo JA, et al. A system for classifying mechanical injuries of the eye (globe). The Ocular Trauma Classification Group. *Am J Ophthalmol* 1997;123(6):820-31. doi:10.1016/S0002-9394(14)71132-8.
3. Kuhn F, Morris R, Witherspoon CD. Birmingham Eye Trauma Terminology (BETT): terminology and classification of mechanical eye injuries. *Ophthalmol Clin North Am* 2002;15(2):139-43. doi:10.1016/S0896-1549(02)00004-4.
4. Kuhn F, Maisiak R, Mann L, Mester V, Morris R, Witherspoon CD. The Ocular Trauma Score (OTS). *Ophthalmol Clin North Am* 2002;15(2):163-5. doi:10.1016/S0896-1549(02)00007-X.
5. Maurya RP, Srivastav T, Singh VP, Mishra CP, Al-Mujaini A. The epidemiology of ocular trauma in Northern India: a teaching hospital study. *Oman J Ophthalmol* 2019;12(2):78-83. doi:10.4103/ojo.OJO_149_2018.
6. Misra S, Nandwani R, Gogri P, Misra N. Clinical profile and visual outcome of ocular injuries in a rural area of western India. *Australas Med J* 2013;6(11):560-4. doi:10.4066/AMJ.2013.1876.
7. Reddy YVR, Sangeetha T, Harshitha C. Clinical profile of ocular trauma in a tertiary care hospital at Kolar district, South India. *Bioinformation* 2025;21(9):3355-8. doi:10.6026/973206300213355.
8. Balla SC, Jha KN, Ramanujam S, Srikanth K, Rajalakshmi AR. Maxillofacial trauma and ocular injuries: reports from a prospective study from Pondicherry, India. *Orbit* 2022;41(4):457-63. doi:10.1080/01676830.2021.1939727.
9. Vasu U, Vasnaik A, Battu RR, Kurian M, George S. Occupational open globe injuries. *Indian J Ophthalmol* 2001;49(1):43-7.
10. Rao LG, Ninan A, Rao KA. Descriptive study on ocular survival, visual outcome and prognostic factors in open globe injuries. *Indian J Ophthalmol* 2010;58(4):321-3. doi:10.4103/0301-4738.64116.
11. Gupta R, Gupta S, Chauhan L. Predicting visual outcome after open globe injury using classification and regression tree model: the Moradabad ocular trauma study. *Can J Ophthalmol* 2019;54(4):473-8. doi:10.1016/j.jcjo.2018.08.004.
12. Toh ZH, Agrawal S, Raje D, Hoskin AK, Agrawal R, Khandelwal R. International globe and adnexal trauma epidemiology study (IGATES): a report from Central India on visual outcome in open globe injuries and correlation with ocular trauma score. *Int Ophthalmol* 2020;40(11):2797-806. doi:10.1007/s10792-020-01429-x.
13. Toh ZH, Shah SM, Chua CH, Hoskin AK, Agrawal R, Shah M. International Globe and Adnexal Trauma Epidemiology Study (IGATES): visual outcomes in open globe injuries in rural West India. *Eye (Lond)* 2023;37(1):88-96. doi:10.1038/s41433-021-01895-2.
14. Shah M, Shah S, Khandekar R. Ocular injuries and visual status before and after their management in the tribal areas of Western India: a historical cohort study. *Graefes Arch Clin Exp Ophthalmol* 2008;246(2):191-7. doi:10.1007/s00417-007-0698-y.
15. Noble FJ, Lahane ST, Lahane TP, Parekh RH, Lahane ST, Dhayதாக PP, et al. Validation of ocular trauma score (OTS) in open- and closed-globe injuries in Indian patients. *Indian J Ophthalmol* 2025;73(Suppl 3):S498-501. doi:10.4103/IJO.IJO_2737_24.