ORIGINAL ARTICLE

Ocular Trauma in Pakistan: Trends, Causes and Medicolegal Implications

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Abstract:

Objectives: To characterize the clinical profile and medicolegal classification of ocular trauma presenting to a tertiary care hospital in Pakistan.

Methods: A retrospective study of 340 medicolegal cases (MLCs) conducted at Bahawal Victoria Hospital, Bahawalpur, from March 2020 to August 2025. Clinical data was retrieved from electronic medical records. Injuries were classified using the Birmingham Eye Trauma Terminology (BETT) system and Section 335 of the Pakistan Penal Code (PPC). Primary outcomes included demographics, mode, severity of injury, and presenting visual acuity. Secondary outcomes were associated injuries and complications. Statistical analysis was done by SPSS version 25. The chi-square test was used to compare the categorical variables, $p < 0.05$ was considered statistically significant.

Results: Males (mean age 35±15 years) predominated (289 cases, 85%). Fist blows were the most common mode (197 cases, 58%). Closed globe injury (CGI) occurred in 243 cases (71.5%), open globe injury (OGI) in 97 (28.5%). Associated injuries included adnexal trauma (67.1%), hyphema (32.9%), and orbital fractures (10%). Endophthalmitis developed in 31 (32%) OGI cases. Presenting visual acuity was ≥ 6/12 in 67.9% of the CGI group and 10.3% of the OGI group. Malingering was diagnosed in 24 cases (7.1%). Based on the PPC, 292 cases (85.9%) were classified as non-grievous hurt, 43 (12.6%) as Itlaf-i-salahiyyat-i-udw (permanent loss of visual function with the eyeball anatomically preserved), and 5 (1.5%) as Itlaf-i-udw (complete loss of the eyeball).

Conclusion: Assault-related ocular injuries predominantly affect young males. The high rate of endophthalmitis in open globe injuries (OGI) mandates timely referral and urgent treatment.
Al-Shifa Journal of Ophthalmology 2026; 22(2): 76-85.

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Originally Received: 10 Jan 2026
Revised: 21 March 2026
Accepted: 10 April 2026

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Introduction:

Medicolegal cases (MLCs) represent a critical intersection between clinical and legal domains. An MLC is defined as a case requiring law enforcement investigation to establish legal responsibility under prevailing statutes[1]. Despite its high frequency in developing countries like Pakistan, comprehensive data on medico-legal aspects of the ocular trauma remains limited[2,3]. The accurate assessment of such cases hinges on two pivotal frameworks: a standardized clinical classification system and a practically applicable legal statute. For standardized clinical categorization, this study employed the Birmingham Eye Trauma Terminology (BETT) System. The BETTS is a universally recognized, standard classification system based upon

the integrity of the globe. The classification divides ocular trauma into Open Globe Injury (OGI), a full-thickness defect of the globe; and *Closed Globe Injury (CGI),* where the eyeball remains intact. BETT further categories the ocular trauma according to anatomical zone of injury (Zone-1, II, III) and the type of trauma like the ruptured globe, ocular penetration, ocular contusion and the intraocular foreign body (IOFB)[4].

Section 335 of the Pakistan Penal Code (PPC) provides legal classification of the bodily injuries**,** classifying them according to the severity of trauma[5]. Three medico-legal categories of trauma include:

1- Non-Grievous Hurt: Injury with no or partial, reversible loss of vision.

2- Itlaf-i-salahiyyat-i-udw: Injury causing permanent, irreversible loss of vision, without loss of the eyeball.

3- Itlaf-i-udw: Permanent loss of the eyeball.

Precise clinical classification of ocular injuries through systems like BETT is therefore a fundamental prerequisite for documenting correct medico-legal status of ocular injuries. The purpose of the present study was to document the demographic, clinical, and medico-legal profile of MLCs at a tertiary care center through the BETT system and the PPC classification, to identify the patterns of injury and the outcome, and to assess the prevalence of malingering in this population, thereby bridging the clinical and medicolegal domains.

Methodology:

A retrospective, descriptive, observational study of 340 MLCs presenting between March 2020 to August 2025, conducted at the department of Ophthalmology, Bahawal Victoria Hospital, Bahawalpur, Pakistan. Approval for the study was taken from the institutional ethical committee of the hospital. The study adhered to the declaration of Helsinki principles. Being a retrospective observational study, the sample comprised of all the medico-legal cases whose medical records were available and fulfilled the inclusion criteria. Data were collected by retrieving the medico-legal records saved in computer section of the department. The documents of all MLCs were thoroughly evaluated for completeness as per the inclusion criteria. Cases having incomplete records were excluded from the final analysis. The study included the cases of all ages and both genders who presented to our department for the treatment, documentation and medicolegal certification of their ocular injuries and gave full informed consent at the time of admission. Uncooperative cases (like children whose clinical examination was incomplete) and the cases whose consent form was not present in retrieved documents were excluded from the study. A patient was labelled as 'MLC' based on one or more of the following standardized criteria:1, A History of assault or suspected foul play. 2, Accidental trauma including road traffic accidents. 3, Patient/guardian request for medicolegal documentation. 4, Clinical judgment of potential legal implications. All MLCs were identified through the department's electronic medical records system using ICD-10 codes for ocular trauma (S05.0-S05.9) cross-referenced with medicolegal registration logs.

Because the highly sophisticated investigations needed for objective assessment and confirmation of malingering (visual evoked potentials, VEP, electroretinography, ERG and electrooculography, EOG) were not available, the diagnosis of malingering relied heavily on clinical suspicion, comprehensive clinical assessment and selective investigations (CT-scan/MRI, ocular B-scan ultrasonography and OCT). The patients were therefore diagnosed for ‘suspected malingering’ instead of ‘confirmed malingering’. Comprehensive clinical ocular examination was performed in all patients presenting as MLCs. Any life-threatening injuries were ruled out prior to performing any ocular examination.

To ensure consistency in clinical assessment, classification of injuries, and proper medicolegal documentation, all the medicolegal examinations and investigations for the present study were conducted by same practitioner. A detailed history was recorded, including the exact mechanism of injury, time of occurrence, location of the incident, and whether any first aid was administered. The presence of symptoms such as pain, photophobia, blurred vision, diplopia, or floaters was specifically elicited. Baseline uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) were assessed using a standard Snellen chart at 6 meters. For patients unable to read the chart, VA was assessed as counting fingers (CF), hand motions (HM), perception of light (PL), or no perception of light (NPL). Near vision was assessed using Jaeger's chart. A systematic examination was performed under adequate illumination. This included inspection of the periocular region for edema, ecchymosis, and lacerations. Eyelid eversion was performed to rule out foreign bodies. The anterior segment was examined using a slit-lamp biomicroscope to assess the conjunctiva, cornea, anterior chamber, iris, and lens for signs of trauma. Pupillary size, shape, and reaction to light (both direct and consensual) were meticulously evaluated. The presence of a relative afferent pupillary defect (RAPD) was tested using the swinging flashlight test. Extraocular movements were assessed in all positions of gazes. After ensuring the absence of a penetrating injury and with pupillary dilation using tropicamide 1% eye drops, a detailed fundus examination was performed using a direct and/or indirect ophthalmoscope to evaluate the status of vitreous, macula, optic disc, and peripheral fundus. Presence of any trauma related pathology such as vitreous hemorrhage, sub-ILM/intra-retinal/subretinal
hemorrhage, macular edema/hole, retinal tears/detachment, and commotio retinae/Berlins edema were assessed and documented. IOP was measured using a Goldmann applanation tonometer. In cases of suspected OGI, tonometry was deferred till surgical closure of the OGI. B-scan USG was performed in all patients having CGI and associated hazy ocular media that precluded posterior segment examination. The sonographic findings were documented in medical record of all the patients. Cases with high clinical suspicion of injuries to cranio-fascial and orbito-nasal skeleton underwent X-rays and computed tomography scans (Head & Neck, Orbit & Nasal cavity/sinuses). The investigation findings were documented in patient's medicolegal records.

Of the 410 retrieved medical records, medico-legal data of 70 Patients was found to be incomplete and these cases were excluded from the analysis. The final sample consisted of 340 cases. The Birmingham Eye Trauma Terminology System (BETTS)[4] was utilized for standardized classification of Ocular injuries. Suspected malingering was identified when the visual acuity testing showed inconsistent responses during repeated assessment (for example a changing visual acuity during repeat test or an inconsistency of monocular versus binocular visual acuity); pupillary reactions were normal, absence of anisocoria, and absent relative afferent pupillary defect (RAPD); the clinical examination was unremarkable for any significant finding (normal slit-lamp biomicroscopy, normal dilated fundoscopy, unremarkable B-scan ultrasonography and radiological examination). Descriptive statistics were calculated using SPSS version 25. Continuous variables were expressed as mean ± SD or median based on distribution. Categorical variables were presented as frequencies and percentages. Chi-square tests compared categorical variables, with $p<0.05$ considered statistically significant.

Results:

During the 5-year study period from March 2020 to August 2025, 340 patients were

registered as medicolegal cases (MLCs) of ocular trauma. Males predominated (289/340, 85.0%) with a male-to-female ratio of 7:1. The age of patients ranged from 7 to 75 years with a mean age of 35 ± 15 years, and the highest incidence occurred in the 21–40-year age group (210/340, 61.8%). Bilateral ocular involvement was observed in 47 patients (47/340, 13.8%). Detailed demographic characteristics are presented in Table 1.

Table 1: Demographic Characteristics of Patients (N=340)

Characteristic	Number of Cases	Percentage
1. Gender		
- Male	289	289/340 (85%)
- Female	51	51/340 (15%)
2. Age (Years)		
≤20	40	40/340 (12%)
21-40	210	210/340 (62%)
41-60	76	76/340 (22%)
>60	14	14/340 (4.0%)
3. Laterality		
- Unilateral	293	293/340 (86%)
- Bilateral	47	47/340 (14%)

Cases having CGI presented relatively sooner (within 6 ± 2 hours of injury) as compared to the cases having OGI (within 18 ± 6 hours of injury), this delay in presentation in OGI group is statistically significant ($p < 0.001$). The most common mechanism of ocular trauma was direct assault by fist blow (197/340, 58.0%), followed by assault with blunt objects (51/340, 15.0%), sharp objects (34/340, 10.0%), road traffic accidents (27/340, 7.9%), chemical injuries (10/340, 2.9%), and other causes (21/340, 6.2%). The distribution of injury mechanisms is summarized in Table 2.

Table 2: Mode of Injury (N=340)

Mode of Injury	Number of Cases	Percent
- Direct Assault (Blow/Fist)	197	197/340 (58%)
- Assault With Blunt Object(s) (Stone/Stick/Iron Bar)	51	51/340 (15%)
- Assault With Sharp Object(s)	34	34/340 (10%)
- Road Traffic Accident	27	27/340 (8%)
- Chemical (Alkali/Acid) Burns	10	10/340 (03%)
*- Others**	21	21/340 (06%)

**Includes falls, projectile injuries.*

Based on the Birmingham Eye Trauma Terminology System (BETTS) classification, closed globe injuries (CGI) constituted the majority (243/340, 71.5%) whereas open globe injuries (OGI) accounted for 97/340 cases (28.5%). Contusion was the most frequent subtype among closed globe injuries. The

anatomical distribution of injuries and presenting visual acuity patterns differed between CGI and OGI cases, with poorer visual acuity observed more frequently in open globe injuries. Detailed injury classification is presented in Table 3.

Table 3: Clinical Classification of Ocular Injuries (BETTS)

Type of Injury	Number Of Patients (N=340)	Percent
1. CGI	243 Eyes	243/340 (71%)
- *Ocular Contusion*	194	194/243 (80%)
- *Lamellar Laceration*	41	41/243 (17%)
- *Superficial Foreign Body*	08	08/243 (03%)
2. OGI	97 Eyes	97/340 (29%)
- *Globe Rupture*	27	27/97 (28%)
- *Ocular Penetration*	46	46/97 (48%)
- *Ocular Perforation*	04	04/97 (04%)
- *IOFB*	20	20/97 (21%)
Anatomical Zone of Injury 1. CGI (N=243)		
- *Zone I*	173	72%
- *Zone II*	31	13%
- *Zone III*	39	16%
2. OGI (N=97)		
- *Zone I*	33	34%
- *Zone II*	37	38%
- *Zone III*	27	28%
Visual Acuity at Presentation 1. CGI		
- *Grade-1: (≥6/12)*	165	67.9%
- *Grade-2: (6/18-6/36)*	32	13%
- *Grade-3: (6/60-3/60)*	20	08%
- *Grade-4: (<3/60-Light Perception (PL)*	18	07%
- *Grade-5: No Perception Of Light (NPL)*	08	03%
2. OGI		
- *Grade-1: (≥6/12)*	10	10%
- *Grade-2: (6/18-6/36)*	09	09%
- *Grade-3: (6/60-3/60)*	23	24%
- *Grade-4: (<3/60-PL)*	32	33%
- *Grade-5: (NPL)*	23	24%

According to Section 335 of the Pakistan Penal Code, the majority of injuries were classified as non-grievous hurt (292/340, 85.9%), while 43 cases (43/340, 12.6%) resulted in permanent visual impairment *(Itlaf-i-salahiyyat-i-udw)* and 5 cases

(5/340, 1.5%) resulted in complete anatomical loss of the globe *(Itlaf-i-udw).* The medicolegal classification of injuries is summarized in Table 4.

Table 4: Legal Framework of Ocular Injuries

SEVERITY OF INJURY*	**NUMBER OF CASES**	**PERCENT**
A. Non-Grievous Hurt	292	292/340 (86%)
B. Itlaf-i-udw *(Complete Loss of the Globe (Eyeball)/Severely Damaged Eyeball Requiring Evisceration/Enucleation)*	05	05/340 (02%)
C. Itlaf-i-salahiyyat-i-udw *(Anatomically preserved Eyeball with Complete loss of visual Function)*	43	43/340 (12%)

**Section 335, PPC*

Associated ocular and orbital injuries were common. Adnexal trauma occurred in 228 patients (228/340, 67.1%), while anterior segment injuries were observed in 105 patients (105/340, 30.9%). Posterior segment involvement was documented in 159 of 243 CGI cases (65.4%) and 50 of 97 OGI cases (51.5%). Endophthalmitis developed in 31 of 97 OGI cases (32.0%), with 19 cases (19/97, 19.6%) requiring evisceration or enucleation. Orbital fractures were detected in 34 patients (34/340, 10.0%), and 24 patients (24/340, 7.1%) met the criteria for suspected malingering. A detailed breakdown of associated injuries and complications is presented in Table 5. Twenty-four patients (7.1%; all females) were diagnosed for suspected malingering on the basis of normal clinical examination and unremarkable radiological investigations.

Table 5: Associated Injuries and Secondary Complications

Clinical Finding	Number Of Cases	Percent (%)
1. Adnexal Injuries	228	228/340 (67%)
A. Periorbital/Subconjunctival Hemorrhage	185	185/228 (81%)
B. Eye Lid Lacerations	43	43/228 (1%)
- Upper Eye Lid	28	28/43 (65%)
- Lower Eye Lid	11	11/43 (27%)
- Both Eye Lids	04	04/43 (09%)
- Associated With Canalicular Laceration	07	07/43 (16%)
2. Anterior Segment Injuries	105	105/340 (31%)
A. Traumatic Cataract	67	67/340 (20%)
- CGI	38	38/243 (16%)
- OGI	29	29/97 (30%)
B. Hyphema	112	112/340 (33%)
- Resolution Without Surgical Intervention	89	89/112 (80%)
- Requiring Surgical Intervention	23	23/112 (21%)
C. Secondary Glaucoma	38	38/340 (11%)

3. Posterior Segment Injuries (CGI)	159	159/243 (66%)
A- Vitreous Hemorrhage	89	89/243 (37%)
B- Pre/Intra/Subretinal Hemorrhage	34	34/243 (14%)
C- Commotio Retinae/Berlin Edema	23	23/243 (10%)
D- Traumatic Macular Hole	08	08/243 (03%)
E- Retinal Detachment	05	05/243 (02%)
4. Posterior Segment Injuries (OGI)	50	50/97 (51.5%)
A- Endophthalmitis	31	31/97 (32%)
B- Severely Damaged Globe (Requiring Evisceration/Enucleation)	19	19/97 (20%)
5. Orbital Injuries	88	88/340 (26%)
Orbital Fracture(S)	34	34/340 (10%)
A- Floor	19	19/34 (56%)
B- Medial Wall	09	09/34 (27%)
C- Combined (Floor and Medial Wall)	06	06/34 (18%)
D- Orbital Injury Requiring Surgery	17	17/34 (50%)
Associated Maxillo-Facial Injuries	14	14/340 (04%)
6. Malingering/Pre-Existing and Self-Inflicted Injuries	24	24/340 (7%)
A. Normal Clinical/ Radiological Examination	18	18/24 (75%)
B. Pre-Existing/Self-Inflicted Injuries Claimed As Medicolegal Injuries	06	06/24 (25%)

Discussion:

An online search of the PubMed/PubMed Central, MEDLINE, Scopus, Web of Science, Google Scholar, EMBASE, and Pak Medinet was performed using the terms like 'medicolegal ocular trauma,' 'medicolegal cases in ophthalmology,' but the search results did not show any single-center study on medicolegal cases with sample as large as of the present study (340 medico-legal cases). Some single-center studies related to ocular trauma were shown including Tripathy et al., 2016[6] and Wasfy et al[7]., 2009 in their study represented the largest single-center study on medicolegal ocular trauma, providing crucial data for both clinical management and legal matters.

The finding that 58% of injuries resulted from fist assault aligns with that reported by the world health organization and the research findings from southeast Asia, confirming a regional pattern of interpersonal violence[8]. The significant association between mechanism of injury and injury type ($p<0.001$) demonstrates that trauma involving sharp object predominantly cause OGI (28.9% vs 2.5% in CGI), while fist assault more commonly results in CGI[9,10]. The 67.1% rate of adnexal trauma exceeds the rates reported in international series[11,12]. The 32.9% incidence of hyphema also substantially surpasses the reported incidence, especially in the adolescent age groups[13,14]. The significantly higher rate of traumatic cataract in OGI (29.9%) as compared to CGI (15.6%; $p=0.003$) reflects greater severity of mechanical energy transfer caused by penetrating injuries, consistent with the findings by Rmili et al., 2024[15].

The 32% incidence of endophthalmitis in OGI cases is substantially higher than the that reported in developed nations[16]. The pattern of clinical findings aligns more with the research findings from South Asian studies[17]. The 19.6% evisceration/enucleation rate in OGI cases is comparable to rates documented in international studies[18]. Higher rates of endophthalmitis in present study is most likely due to delayed presentation to

healthcare facilities, specially the cases having OGI, other factors include contaminated wound in agricultural injuries, and antimicrobial resistance in our locality. The 7.1% malingering rate occurring exclusively among females ($p<0.001$) requires careful interpretation. While 5.8% rate of malingering was reported in India with 60% female prevalence[19,20]. 100% female prevalence rate in our study may reflect gender-based differences in healthcare utilization, or sociocultural factors affecting the compensation claims.

Our distribution of injury severity (85.9% non-grievous, 12.6% partial or functional visual loss, and 1.5% complete visual impairment) differs from the findings reported in several regional and international medicolegal studies. Such differences may reflect variations in trauma patterns, referral bias, or differences in legal interpretation between jurisdictions[21,22,23,24]. In our cohort, the strong association between open globe injury and higher legal grades (OR 8.3, $p<0.001$) provides objective clinical data that may support medicolegal evaluation and compensation determinations[25]. The significant difference in visual acuity between CGI and OGI ($p<0.001$), with preserved vision (≥6/12) in 67.9% of CGI cases versus only 10.3% of OGI cases, confirms findings from Ocular Trauma Score [26,27]. The significantly higher rate of NPL in OGI (23.7%) compared to CGI (3.3%; $p<0.001$) mirrors the findings from the regional studies reporting the devastating nature of open globe injuries, emphasizing the importance of prevention[28].

Based on the findings of our study we recommend community-based conflict resolution programs targeting the 21–40 age groups. The 32% endophthalmitis rate in OGI underscores the need for standardized primary repair protocols with mandatory intravitreal antibiotic prophylaxis in open globe cases. The gender-specific pattern of suspected malingering (100% female) suggests the need for sensitive medicolegal screening protocols that account for domestic violence dynamics. The need for targeted public health initiatives aimed at educating the public on the importance of protective headgear, such as helmets, to safeguard the head, neck, and facial region.

The present study is single-center medicolegal ocular trauma study with largest cohort, supporting the novelty and scale of the present analysis. Additionally, this is the first study from Pakistan that utilize two classification frameworks, the BETTS for clinical classification and PPC for legal framework. Limitations of the study include its retrospective design, which introduces the possibility of incomplete data capture. The referral bias, whereby severe and complex cases are preferentially referred from primary and secondary facilities; and the documentation-seeking bias, whereby patients selectively present to a medicolegal-designated center to obtain medicolegal certification. Consequently, the proportion of OGI, endophthalmitis, and higher-grade PPC classifications in our cohort may exceed those observed in community-based settings. Future multicenter studies incorporating primary and secondary care data are needed to establish true population-level incidence. Additionally, the COVID-19 pandemic period may also have affected the injury patterns and presentation[28].

Conclusion:

The study demonstrates that assault related ocular injuries predominantly affect young males, blows with the fist being the most common mechanism. CGI constituted the majority of cases, whereas OGI were associated with delayed presentation and poorer visual prognosis. A high frequency of associated injuries, and endophthalmitis was found in our study. Most cases had injuries that were legally non-grievous, only a smaller proportion resulted in permanent visual loss or loss of the eyeball.

These findings highlight the clinical spectrum and medicolegal burden of ocular trauma presenting to a tertiary care center in Pakistan.

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