Original Article

Systematic analysis of ocular trauma by a new proposed ocular trauma classification

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Purpose: The current classification of ocular trauma does not incorporate adnexal trauma, injuries that are attributable to a nonmechanical cause and destructive globe injuries. This study proposes a new classification system of ocular trauma which is broader-based to allow for the classification of a wider range of ocular injuries not covered by the current classification. **Methods:** A clinic-based cross-sectional study to validate the proposed classification. We analyzed 535 cases of ocular injury from January 1, 2012 to February 28, 2012 over a 4-year period in an eye hospital in central India using our proposed classification system and compared it with conventional classification. **Results:** The new classification system allowed for classification of all 535 cases of ocular injury. The conventional classification was only able to classify 364 of the 535 trauma cases. Injuries involving the adnexa, nonmechanical injuries and destructive globe injuries could not be classified by the conventional classification, thus missing about 33% of cases. **Conclusions:** Our classification system shows an improvement over existing ocular trauma classification as it allows for the classification of all type of ocular injuries and will allow for better and specific prognostication. This system has the potential to aid communication between physicians and result in better patient care. It can also provide a more authentic, wide spectrum of ocular injuries in correlation with etiology. By including adnexal injuries and nonmechanical injuries, we have been able to classify all 535 cases of trauma. Otherwise, about 30% of cases would have been excluded from the study.

Key words: Adnexal injury, closed globe injury, destructive globe injury, nonmechanical injury, open globe injury

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A standardized system of defining and classifying is integral to the understanding of a subject and to aid communication between clinicians. Devising a classification system in medical science is often a challenging task due to complexity and variability of human anatomy and physiology. Systems of classification evolve with growing knowledge and understanding of a disease. Useful classifications often undergo changes or are replaced by new ones. The earlier classifications of ocular trauma[1] have certain limitations, and with evolving technology and understanding of the subject, there is a scope to reclassify injuries to the eye for better understanding. In addition, terms such as abrasion, ulceration, penetration, perforation, rupture, and laceration were not clearly defined in previous classification systems. Different words were used to describe the same lesion or different lesions were described using the same word.[1-6]

In 1996, Kuhn *et al*.[1] defined various terms used in ocular trauma and made a classification of ocular trauma for mechanical eye injuries. This has received recognition from many national and international societies and is the currently adopted common language for ocular trauma among general ophthalmologists. In this conventional classification [Fig. 1], mechanical eye injuries were classified into closed and open globe types. In the closed globe type, there was no full thickness wound in the eye wall, whereas in the open globe type, there was a full thickness wound. Eye wall was defined as the corneal and sclera coat. These two types were further divided into subtypes. Most of the eye injuries can be classified by this method. In 1997, Pieramici *et al*.[2] published a similar article on classification of mechanical injuries, but neither classification system considers nonmechanical injuries and certain structures of the eye.

In 2009, a new classification of ocular trauma was proposed.[3] The authors suggested that the term "ocular trauma" include structures of ocular adnexa such as the lids, orbit, lacrimal apparatus, and the conjunctival and not just the eyeball or globe. The objective of this study was to make a systematic analysis of cases of ocular trauma with a new classification system, which would include all types of ophthalmic trauma and also be potentially helpful in specific prognostic outcome. The mechanical eye injuries classification system is a useful tool for segregating most cases of ocular trauma, but the injuries sustained to the eye are due to complex composite mechanisms which are nonmechanical.

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Furthermore, other forms of nonmechanical injuries can lead to open globe injuries or similar lesions in eyes with closed globe injuries, so it becomes prudent to include the nonmechanical form of trauma in the classification system for ocular injuries.

Methods

All cases of ocular trauma were analyzed and evaluated at a tertiary referral eye care center in central India from January 1, 2012 to February 28, 2012, over a period of 4 years using our proposed new system of classification for ocular trauma [Fig. 2]. In all cases of ocular trauma, a detailed history, clinical examination and all necessary investigation were carried out.

All cases were divided into local or associated injuries. Local injury cases had trauma limited to the eyeball and ocular adnexa. Associated injury cases had globe trauma with either head injury, face injury, or multiple injuries known as polytrauma.

The group with only local injuries was further divided into mechanical and nonmechanical types. Mechanical injuries were divided into adnexal and global injuries. Nonmechanical injuries included chemical, thermal, radiation, and electrical. Adnexal injuries included orbital, palpebral, lacrimal, and conjunctival. Global injuries were further divided into structural and pathological types. Structural included either anterior or posterior segment type. In the pathological type were closed globe, open globe, and destructive globe types.

Results

The results are summarized in Fig. 2. There were 535 cases of ocular trauma in all. The most common cause of injuries was due to casual daily activities, usually conducted at home (41.7%) followed by sports-related (16.8%) and agriculture-related injuries (14.6%). Most injuries (93.8%) were local and had no associated injuries.

For ocular injuries that had associated injuries, facial injuries (84.8%) were the most common, followed by multiple injuries (15.2%). There were no cases of head injury in our study. Mechanical injuries (91.8%) were a more common cause of local injuries than nonmechanical injuries (8.2%). For mechanical injuries, most involved the globe (68%) followed by the adnexal (20.4%) and the least common were destructive globe injuries (11.8%). For injuries involving the adnexal, the palpebral (20.4%) was involved in most commonly followed by the conjunctival (29%). The most common cause of nonmechanical injury was thermal injury (45.4%) followed by chemical (31.8%) injury.

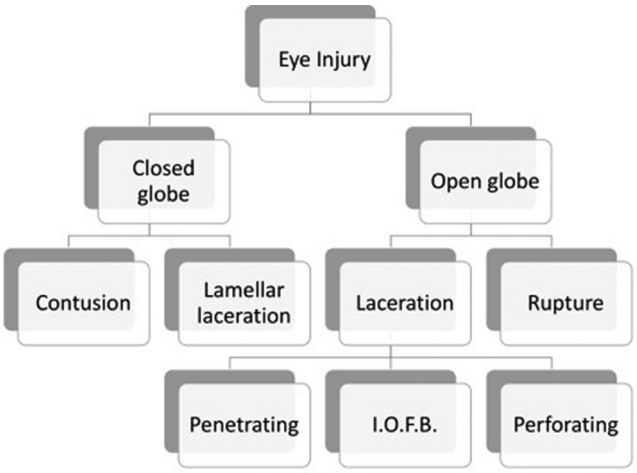

Figure 1: Adapted from Birmingham eye trauma terminology system (present classification)

We were able to classify 472 cases of ocular trauma using the anatomical classification, illustrated in Table 1. There were more anterior segment injuries (86%) than posterior segment injuries (14%). The most common anterior segment injury was injury to the cornea (53.1%) followed by injury to the lens (27.4%). The most common posterior segment injury was to the retina (43.3%) followed by injury to the choroid (11.9%).

We classified injuries involving the globe based on pathology into closed globe injury (66.7%), open globe injury (26.7%), and destructive globe injuries (6.7%) [Table 2]. As conventional classification included only the former two, 27 destructive globe injuries would not have been classified. The most common closed globe injury was that of a contusion (66.6%) followed by lamellar laceration (17.4%). The most common open globe injury was that of a rupture (46.3%). Phthisis bulbi was the most common destructive globe injury followed by endophthalmitis (29.6%).

Discussion

The objective of the current study was to make the classification of ocular trauma more comprehensive and broad based. The study found that a fifth of mechanical injuries involved the ocular adnexa. This is a large number, and these injuries would have been missed in the current classification. Other studies on ocular trauma have also found a large number of adnexal injuries affecting the outcome.[4,5] These injuries were significant as the exclusion of adnexal injuries significantly affected results.[4,5] In classification and regression tree analysis, authors have very clearly demonstrated the influence of lid and adnexal injury on the outcome.[5] The conventional Birmingham Eye Trauma Terminology system (BETTS) classification, though robust, does not include a comprehensive spectrum of ophthalmic trauma. The existing classification system, though able to prognosticate the outcome, is still not comprehensive and does not include all the ocular structures. In addition, the creation of a new category for the pathological classification of ocular trauma allowed for the categorization of another 27 cases, which represent 5% of all cases. Nonmechanical injuries represented a significant number, and these were also analyzed thanks to the new classification system.

Table 1: Classification by anatomy of globe injuries

Anterior segment (86%)		Posterior segment (14%)	
Structure	Cases (%)	Structure	Cases (%)
Cornea	215 (53.1)	Vitreous	26 (38.8)
Anterior sclera	20 (4.4)	Retina	29 (43.3)
Iris	61 (15.1)	Choroid	8 (11.9)
Lens	109 (27.4)	Posterior sclera	4 (6.0)
Total	405 (100)	Total	67 (100)

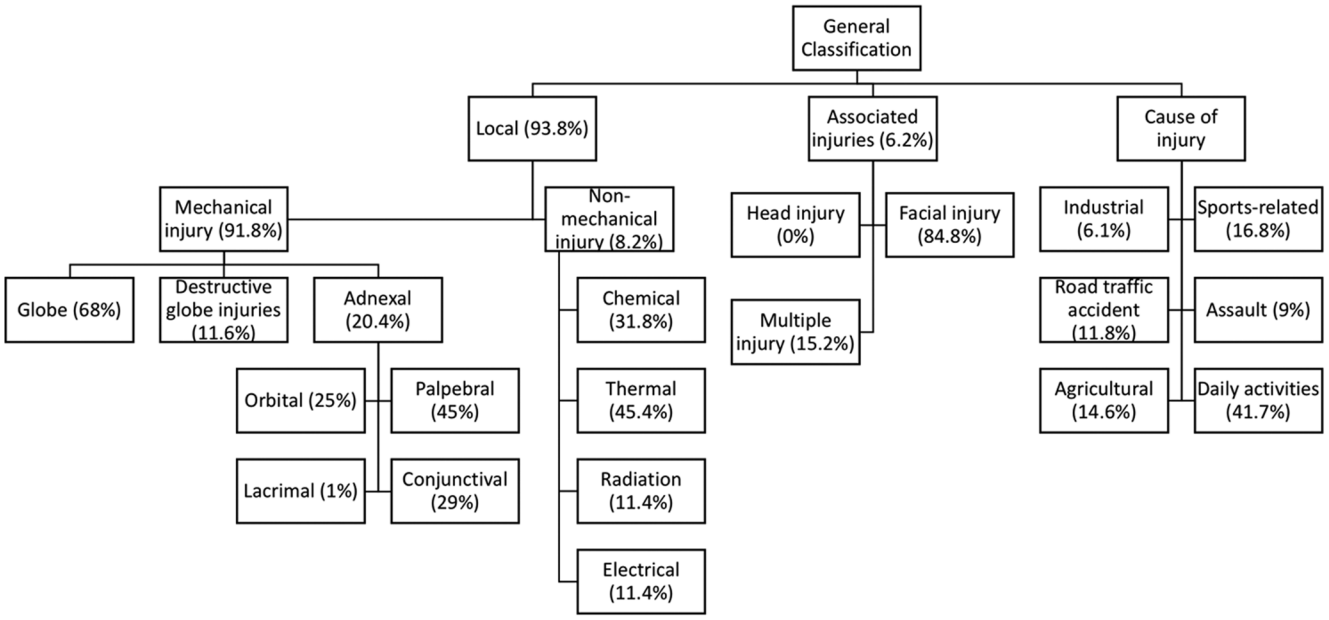

Figure 2: The proposed new classification of ocular trauma

Table 2: Classification by pathology of globe injuries

Closed globe injury		Open globe injury		Destructive globe injuries (not included in conventional classification)	
Type	**Cases (%)**	**Type**	**Cases (%)**	**Type**	**Cases (%)**
Contusion	180 (66.6)	Rupture	50 (46.3)	Traumatic evisceration	2 (7.4)
Lamellar laceration	47 (17.4)	Penetration	30 (27.7)	Traumatic enucleation	0
Extra ocular foreign body	28 (10.4)	Perforation	16 (14.9)	1/3 full thickness laceration	6 (22.3)
Intramural foreign body	15 (5.6)	Intraocular foreign body	12 (11.1)	Pthisis bulbi	11 (40.7)
				Endophthalmitis	8 (29.6)
Total	270 (100)	Total	108 (100)	Total	27 (100)

Using conventional classification, 171 cases would not have been classified. This would have resulted in missing about 33% (one-third) of cases. Hence, our proposed classification system holds significant advantages over the current conventional classification system.

The number of ocular trauma cases with associated injuries was lower than expected (6.2%). This data are not truly representative, as most of these cases would have been admitted to a general hospital for management of other injuries. This study was conducted in an eye hospital where only a few such cases are presented. This limitation can be overcome by working with a general hospital, which caters to all types of injury.

In addition, a large number of injuries were caused by daily activities and occurred at home. The domestic injuries probably occurred due to the lack of awareness, lack of home safety, and easy access to certain dangerous objects at home like knives, scissors, bow and arrow, and toy guns. Agricultural injuries were mainly due to branches, shrubs, and animals such as cows and buffalos from horns and tails. These injuries are likely to cause fungal infections. As central India is still in the midst of developing industries, these injuries constituted a small proportion. For a similar reason, mechanical injuries were much higher.

A limitation of the conventional classification system is that it does not allow for the clinician to prognosticate. The Ocular Trauma Score was designed to predict visual outcomes in open globe injuries.[6] Neither does it consider adnexal injuries. Pure adnexal injuries are unlikely to affect the visual outcome, although they might affect cosmesis. BETTS can be used to describe mechanical globe trauma as a standardized international language of ocular traumatology.[1,6] However, it fails to describe nonmechanical globe trauma, which makes up a significant proportion of eye injuries.

Conclusions

The conventional system has been a useful classification system for the last two decades. However, one of its major limitations is that it is not sufficiently comprehensive and a third of ocular trauma cases cannot be classified by adopting this conventional classification system. The conventional classification system was the basis for the development of our newly proposed classification system. Our system aimed to classify all cases of ocular

trauma, and we were able to do so with the addition of three categories, namely, nonmechanical injury, adnexal injury, and destructive globe injuries. This proposed classification can be adopted for further multicenter study as it represents the most current available knowledge of ocular trauma.

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Conflicts of interest

There are no conflicts of interest.

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