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To study the outcome in various types of ocular trauma as per BETT'S classification in Northern UP.

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I. INTRODUCTION

Ocular trauma is a leading cause of unnecessary blindness and visual impairment. Although they have a significant financial impact, there is very little information on the extent and risk factors of ocular trauma. Trauma to the eye can cause anything from a small sub conjunctivalhaemorrhage to a ruptured eyeball. Patients who present with significantly decreased visual acuity usually do not have a good outcome. Because the eye tissue is so delicate, delayed presentation worsens the visual outcome. The cost of rehabilitation, the need for medical care, and other effects of eye damage highlight the importance of increasing preventive measures. Numerous ocular hazards can be avoided if the public is made aware of potential risk factors and damaging factors[1-3].

The leading preventable cause of monocular blindness and visual impairment is ocular trauma. Each year, an estimated 2.0 to 2.4 million cases of ocular trauma are reported in the United States, many of which result in irreversible vision loss [5-6]. Severe trauma-related eye injuries pose a threat to vision. Minor ocular injuries are associated with significant morbidity and loss of productivity [7].

The International Society of Ocular Trauma of The United States Eye Injury Registry has developed standardized language for eye injuries to facilitate identification of the eye condition, as it has been difficult to categorize the different types of eye injuries. Definitions for commonly used terms related to ocular injuries were provided by the Birmingham Eye Trauma Terminology (BETT) system [8]. The Ocular Injuries Score was developed to provide a single probability estimate of whether a patient with ocular trauma would still be able to see a given area after six months. By considering a range of characteristics, it is used to standardize the assessment and visual prognosis of eye injuries. The likelihood that all possible visual outcomes six months later will understand a subject and the ease of communication with the physician both depend on a consistent system of identification and categorization. Because of the complexity and diversity of human anatomy and physiology, developing a classification system in medical science is often a difficult undertaking. Classification systems change as we learn more and as we better understand a disease. Useful classifications are frequently updated or replaced by new ones. The older classifications of eye trauma [8] have some limitations, and as technology advances and our knowledge of the subject increases, it may be possible to reclassify eye injuries. In addition, previous classification schemes lacked a clear definition for terms such as abrasion, ulceration, penetration, perforation, rupture, and tear. The same lesion was described with different terms, or different lesions were described with the same term [19-12].

In 1996, Kuhn et al. [13] classified ocular trauma for mechanical eye injuries and defined a set of terms used in ocular trauma. Many national and international associations have recognized this, and general ophthalmologists now use this terminology as the standard terminology for eye trauma. Mechanical eye injuries have been divided into those with the eyeball closed and those with the eyeball open in this traditional classification. Using this method, the majority of eye injuries can be categorized. The mechanical eye injury categorization system is a useful tool for identifying most cases of eye injury, although eye injuries are often caused by complex, compound mechanisms that are not mechanical. It is advisable to include nonmechanical trauma in the ocular injury classification scheme because other nonmechanical trauma may result in open globe injuries or similar lesions in eyes with closed globe injuries. In this study, we aim to evaluate the factors that influence visual outcome in different types of ocular trauma according to Bett's classification scheme.

II. MATERIALS AND METHODS:

This hospital-based, prospective, observational study was conducted at the Regional Institute of Ophthalmology, Sitapur Eye Hospital (UP). All patients with ocular trauma were recruited from March 2021 to February 2022 in the outpatient clinic and emergency department. A total of 75 patients with ocular trauma were enrolled in this study, and the inclusion and exclusion criteria were precisely defined after approval by the ethics committee of the institution. Written informed consent was obtained from each patient in his or her own language. Patients of all ages with ocular injuries were included. Patients with birth injuries, thermal injuries, ultrasound injuries, radiation injuries, old healed trauma, other morbid injuries requiring emergency treatment, orbital rim fractures, and patients with a history of ocular problems affecting visual acuity were excluded.

A complete ophthalmologic examination was performed in all patients. Age, sex, site of injury, type of injury, extent of injury, and time of injury were recorded. Detailed flashlight, best-corrected visual acuity using the Snellen chart and LOGMAR, slit lamp and indirect ophthalmoscope (90D/78D/20D), intraocular pressure using Goldmann Applanation tonometry or noncontact tonometry (except for open globe injuries), and USG-B scan were examined to determine posterior segment involvement. Ocular injuries were graded according to Bett's classification.

All patients were divided into two main groups according to the BETT classification and further subdivided into subgroups. They were treated medically or surgically accordingly. Follow-up examinations were performed on the first day, after 1 week, and after 6 weeks to check visual acuity, intraocular pressure, and structural integrity (in terms of size and functionality). Blood pressure, blood glucose, blood count, CT, BT, ESR, viral markers, CT, head and orbit scans, and MRI reports were obtained from the patients' medical records.

III. STATISTICAL ANALYSIS

Statistical analysis was performed with the SPSS for Windows programme, version 23.0 (SPSS, Chicago, Illinois). Values are expressed as mean, median, ±SD, minimum, maximum, number, and percentage. Continuous variables were presented as mean ± SD and categorical variables as absolute numbers and percentage. Normally distributed continuous variables were compared with the unpaired t test. Categorical variables were analysed with either the chi-square test or Fisher's exact test. More than two groups were analysed with the ANOVA test. A value of $P < 0.05$ was considered statistically significant.

IV. RESULTS:

A total of 72 patients with ocular trauma were included in this study. The percentages of the age groups 1-10 years, 11-20 years, 21-30 years, 31-40 years, 41-50 years, and > 50 years were 33.33%, 20.83%, 19.44%, 12.50%, 11.11%, and 2.78%, respectively. The highest incidence of ocular trauma was found in the age groups ≤ 20 years. The percentages of males and females were 76.39% and 23.61%, respectively. The percentages of wood, iron, plants, stones, metals, nails, insects, blunt and sharp objects, plastics, unknowns, FB, and sports equipment were 22.22%, 22.22%, 0.00%, 4.17%, 0.00%, 1.39%, 1.39%, 12.50%, 6.94%, 8.33%, 4.17%, 15.28%, and 1.39%, respectively (Table 1).

Table 1: Baseline characteristics of the patients

	Age group	n	%
Age	1-10 years	24	33.33
	11-20 years	15	20.83
	21-30 years	14	19.44
	31-40 years	9	12.50

	41-50 years	8	11.11
	>50 years	2	2.78
Gender	Male	55	76.39
	Female	17	23.61
Mode of Injury	By Wood	16	22.22
	By Iron	16	22.22
	By Vegetative	0	0.00
	By Stone	3	4.17
	By Metals	0	0.00
	By Nails	1	1.39
	By Insect	1	1.39
	By Blunt	9	12.50
	By Sharp	5	6.94
	By Plastic	6	8.33
	Unknown	3	4.17
	FB	11	15.28
	Sport equipment	1	1.39

The percentages of normal, torn, and swollen eyelid appendages were 61.11%, 2.78%, and 36.11% at baseline, 68.12%, 2.90%, and 28.99% on the first postoperative day, 95.65%, 2.90%, and 1.45% on the first postoperative week, and 100.00%, 0.00%, and 0.00% on the sixth postoperative week in the right eye. Lid appendages of the right eye (OD) improved significantly from baseline to postoperative week 6 (Table 2).

The percentages of normal, torn, and swollen eyelid appendages were 69.44%, 4.17%, and 26.39% at baseline, 82.61%, 2.90%, and 14.49% at the first postoperative day, 97.10%, 1.45%, and 1.45% at the first postoperative week, and 97.10%, 1.45%, and 1.45% at the sixth postoperative week in the right eye. Lid appendages of the left eye (OS) improved from baseline to postoperative week 6 but were not significantly different (Table 2).

Table 2: Changes in Lid adnexa in OD from baseline to post-operative 6 week.

	OD									
	Baseline (n=72)		**Post Op 1 day (n=69)**		**Post Op 1 week (n=69)**		**Post Op 6 week (n=69)**		**Chi Sq.**	**p-Value**
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
Normal	44	61.11	47	68.12	66	95.65	69	100.00	55.04	<0.001*
Laceration	2	2.78	2	2.90	2	2.90	0	0.00		
Swelling	26	36.11	20	28.99	1	1.45	0	0.00		
Normal	50	69.44	57	82.61	67	97.10	67	97.10	32.22	<0.001*
Laceration	3	4.17	2	2.90	1	1.45	1	1.45		
Swelling	19	26.39	10	14.49	1	1.45	1	1.45		

Table 3 shows the changes in conjunctival congestion at OD and OS from baseline to postoperative week 6. The percentages of yes, no, and sub conjunctival haemorrhages were 41.67%, 48.61%, and 9.72% at baseline, 54.29%, 42.86%, and 2.86% on the first postoperative day, 87.14%, 12.86%, and 0.00% on the first postoperative week, and 92.86%, 7.14%, and 0.00% on the sixth postoperative week on the right eye. The percentage of yes, no, sub conjunctivalhaemorrhage and lacrimal congestion was 51.39%, 44.44%, 4.17% and 0.0% at baseline, 70.00%, 25.71%, 4.29% and 0.00% on the first postoperative day, 82.86%, 11.43%, 2.86%, and 2.86% in the first postoperative week, and 90.00%, 4.29%, 2.86%, and 2.86% in the sixth postoperative week in the left eye. Conjunctival congestion of the right eye (OD) and left eye (OS) improved significantly from baseline to postoperative week 6.

Table 3: Changes in Conjunctiva congestion in OD and OS eye from baseline to post-operative 6 week.

Conjunctiva congestion		OD									
		Baseline (n=72)		Post Op 1 day (n=70)		Post Op 1 week (n=70)		Post Op 6 week (n=70)		Chi Sq.	p-Value
		n	%	n	%	n	%	n	%		
OD	Yes	30	41.67	38	54.29	61	87.14	65	92.86	6.31	<0.001*
	No	35	48.61	30	42.86	9	12.86	5	7.14		
	Sub-conjunctival hemorrhage	7	9.72	2	2.86	0	0.00	0	0.00		
	Tear	0	0	0	0.00	0	0.00	0	0.00		
OS	Yes	37	51.39	49	70.00	58	82.86	63	90.00	43.74	<0.001*
	No	32	44.44	18	25.71	8	11.43	3	4.29		
	Sub-conjunctival hemorrhage	3	4.17	3	4.29	2	2.86	2	2.86		
	Tear	0	0.0	0	0.00	2	2.86	2	2.86		

*=Significant (p<0.05)

Anterior chamber hyphaemia in the right eye (OD) improved significantly from baseline to postoperative week 6. Anterior chamber hyphaemia in the left eye (OS) improved from baseline to postoperative week 6 but was not significantly different (Table 4).

Table 4: Changes in anterior chamber at OD from baseline to postoperative week 6

Anterior chamber		OD									
		Baseline (n=72)		Post Op 1 day (n=70)		Post Op 1 week (n=70)		Post Op 6 week (n=70)		Chi Sq.	p-Value
		n	%	n	%	n	%	n	%		
OD	Normal	51	70.83	66	94.29	68	97.14	62	88.57	43.39	<0.001*
	Irregular										
	<1/2 AC	11	15.28	3	4.29	2	2.86	2	2.86		
	>1/2 AC	5	6.94	1	1.43	0	0.00	0	0.00		
	Full chamber	3	4.17	0	0.00	0	0.00	6	8.57		
	AC formed with fibrin	2	2.78	0	0.00	0	0.00	0	0.00		
	Hypopyon	0	0.00	0	0.00	0	0.00	0	0.00		
OS	Normal	60	83.33	69	98.57	69	98.57	67	95.71	24.57	0.057
	Irregular										
	<1/2 AC	6	8.33	0	0.00	1	1.43	3	4.29		
	>1/2 AC	1	1.39	0	0.00	0	0.00	0	0.00		
	Full chamber	2	2.78	0	0.00	0	0.00	0	0.00		
	AC formed with fibrin	2	2.78	1	1.43	0	0.00	0	0.00		
	Hypopyon	1	1.39	0	0.00	0	0.00	0	0.00		

Theiris prolapse in left eye (OS) and right eye (OD) from baseline to post-operative 6 week was improved but not significantly different (Table 5).

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Table 5: Changes in Iris prolapse in OS from baseline to post-operative 6 week.

Iris prolapse		OD									
		Baseline (n=72)		Post Op 1 day (n=70)		Post Op 1 week (n=70)		Post Op 6 week (n=70)		Chi Sq.	p-Value
		n	%	n	%	n	%	n	%		
OD	Yes	49	68.06	63	90.00	63	90.00	65	92.86	45.61	<0.001*
	No	29	40.28	4	5.71	5	7.14	4	5.71		
	iris tear	3	4.17	3	4.29	2	2.86	1	1.43		
	not seen	1	1.39	0	0.00	0	0.00	0	0.00		
OS	Yes	27	37.50	61	87.14	61	87.14	65	92.86	105.69	<0.001*
	No	42	58.33	6	8.57	4	5.71	2	2.86		
	iris tear	1	1.39	3	4.29	5	7.14	3	4.29		
	not seen	2	2.78	0	0.00	0	0.00	0	0.00		

The percentages of lacerations, ruptures, penetrating injuries, and perforating open eye injuries were 10.53%, 21.05%, 47.37%, and 21.05% in the right eye (OD) and 33.33%, 16.67%, 33.33%, and 16.67% in the left eye (OS), respectively. The percentages of open lamellar lesions and contusion lesions were 30% and 70% in the right eye (OD) and 63.64% and 36.36% in the left eye (OS), respectively (Table 6).

Table 6: The details of open and closed globe injuries in OD and OS

		OD			OS		
		Total	n	%	Total	n	%
Open globe injury	Laceration	19	2	10.53	12	4	33.33
	Rupture		4	21.05		2	16.67
	Penetrating injury		9	47.37		4	33.33
	Perforating		4	21.05		2	16.67
Close globe injury	Lamellar laceration	10	3	30.00	11	7	63.64
	Contusion		7	70.00		4	36.36

V. DISCUSSION

In this study, the most commonly affected age groups were children under 11 years of age (33.33%), followed by young adults between 11and 20 years of age (20.83%), and the 21-30 years age group (19.44%). In addition, the highest incidence of eye trauma was found in the age group of ≤30 years (73.60%). Similarly, one study reported that children under 11 years of age were the most commonly affected age group (n = 36, 35.3%), followed by young people aged 21-30 years (n = 23, 22.5%) [14]. Eye injuries occurred most frequently in younger people under 30 years of age (80.5%), with an age peak in those under ten years of age and adults between 21and 30 years of age. Other studies reported that eye injuries were common in middle-aged adult patients [15,16]. Another study also showed that ocular trauma was more common in younger people under 30 years of age (59.77%) [17].

In our study, eye injuries were more common in men (76.39%) with a male-to-female ratio of 3.24. Eye injuries were more common in men than in women with a ratio of 2.8:1 (75 men and 27 women). Previous studies have shown that men suffer eye injuries more frequently than women [14]. Similar descriptions were made for our study participants with a ratio of 2.8:1. Other studies show that middle-aged males are more likely to suffer ocular trauma in adult patients [15,16]. The high proportion of male and young patients has been associated with the propensity of males to engage in risky behaviour, playing more adventurously as children than their female counterparts and choosing more physically demanding occupations as adults [19,20]. The male-to-female ratio was 3:1, with men more likely to be involved (n=104 or 76%) than women (n=32 or 24%) [18]. Men are more likely than women to be exposed to hazardous outdoor work and therefore have a higher risk of sustaining eye injuries [17]. According to Lavaju et al (2022), men were disproportionately affected (76%). Similar findings have been noted in many other studies [21]. Men are more likely than women to be exposed to hazardous outdoor work, making them more susceptible to eye injury.

In our study, the most common injury types were wood and iron (44.44%), followed by FB (15.28), then blunt (12.50%), sharp (6.94%), and plastic (8.33%). A previous study also demonstrated that wooden stick was the most common cause of injury (36%) [21]. Our results are in good agreement with the findings of several previous studies [11,21-24] that the majority of injuries (n = 62, 60.78%) were caused by blunt trauma. Organic material, such as twigs or wood, was the most common cause (n = 38, 37.3%). Most eye injuries in adults (n = 24/50; 48%) were caused by assault, but children (n = 30; 57.7%) frequently injured themselves while playing. Most injuries in children (n = 32; 61.6%) occurred at home, whereas most injuries in adults (n = 19/50; 38%) occurred on the road. Sharp or blunt objects can cause mechanical eye injuries. According to the results of the current study, blunt objects consistently cause the most mechanical eye injuries [25].

In this study, the range was from 1 to 70 days of trauma (days) and presentation to OPD (days) of patients with ocular trauma. The mean duration of trauma (days) and presentation to the OPD (days) was 8.33±13.11 days and 8.91±13.37 days, respectively. One study reported that the injury had been present for a total of 2 days, with durations ranging from 1to 4 days [11]. It was also reported that the duration of injury before presentation was 48% within 1 day and 52% after 1 day.

In our study, visual status based on BCVA in the right and left eyes improved from baseline to the postoperative 6-week period but did not differ significantly. Ocular trauma is one of the most common causes of monocular visual impairment and blindness [26]. The incidence of monocular blindness 8 weeks after therapy was 25.3% [11]. Between 34.3% and 76.6% of people in Ghana and Ethiopia are monocularly blind according to several studies [16,27]. Although monocular blindness is not considered legally blind, these injuries are important because they affect stereopsis, binocular visual field, cosmosis, and future professional life [28]. After ocular trauma, severe open eyeball injuries, endophthalmitis, corneal scarring, and phthisis bulbi were the sequelae leading to monocular blindness after 8 weeks.

In our study, eyelid appendages, conjunctival congestion, cornea, anterior chamber hyphaema, and iris prolapse in the right and left eyes improved significantly from baseline to the 6-week postoperative period. In one study, it was found that only 16.17% of our patients had visual acuity of 6/60 or more at the time of presentation (83.83%), most of them [21]. At the four-month follow-up [29-31], percent had visual acuity better than 6/60, and the difference between final visual acuity at OGI and CGI was statistically significant. One study found that 40% of patients had visual acuity between 6/60 and 3/60 at presentation, while 26.7% had visual acuity better than 6/60 [11]. Visual acuity better than 6/60 increased from 16% to 68% at two-month follow-up. According to Khatry et al, 26.4% of patients had visual acuity less than 20/60 in the injured eye and 9.6% had visual acuity less than 20/400 on arrival at the clinic [32]. After four months, Agrawal et al. found that 441 (65.9%) of the participants had achieved visual acuity greater than 20/40, 84 had VA between 20/50 and 20/200, and 144 (21.5%) had VA less than 20/200 [33]. Differences in population, factors, and type of injury may account for these differences in visual acuity. Numerous studies have been conducted to determine the relationship between the preoperative parameters associated with ocular injuries and the final visual outcome. According to these, the location, size, and severity of the injury, as well as the degree of ocular damage, had an impact on the final visual outcome [13].According to Agrawal et al, the time interval between accident and surgery, the age of the patient, and the type of injury were the factors that negatively affected the final visual outcome. Only at the level of univariate analysis, they found that preoperative visual acuity affected postoperative visual acuity [33]. The time period between the accident and surgery had a negative impact on the final visual outcome. For each day that surgery is delayed, the likelihood of a worse visual outcome increases 1.16-fold [33]. The importance of good visual acuity at the time of presentation in open eye injuries has also been reported in previous studies [28].

VI. CONCLUSIONS:

The present study was carried out to evaluate the factors, mode of injury and clinical profile affecting visual outcome of ocular trauma as per Bett's classification. For this purpose, the hospital-based, prospective, observational study was carried out that included a total 72 ocular trauma patients are enrolled in this study. The following findings from the study were drawn:

- The most affected age groups were children under 11 years old (33.33%) followed by young adults between 11–20 years (20.83%), then 21-30 years age group (19.44%). Moreover, the maximum incidence of ocular trauma was found in ≤30 year's age groups (73.60%).
- The ocular injury was more common in male 76.39% with male:female ratio 3.24.
- The mode of injuries were most common by wood and Iron (44.44%), followed by FB (15.28), then blunt (12.50%), by sharp (6.94%) and by Plastic (8.33%).
- The range of duration was 1 to 70 day of trauma (days) and presentation in OPD (days) of ocular trauma patients.
- The mean duration of Trauma (days) and presentation in OPD (days) was 8.33±13.11 days and 8.91±13.37.
- The vision statuses on the basis of uncorrected visual acuity (UCVA) in right and left eye were good vision (51.39% and 63.89%), moderate vision (6.94% and 4.17%), severe vision (22.22% and 16.67%) and very severe vision (19.44% and 15.28%).
- The vision status on the basis of BCVA in right eye and left eye from baseline to post-operative 6 week was improved but not significantly different.
- The lid adnexa, conjunctiva congestion, cornea, anterior chamber hyphaema and Iris prolapse in right eye and left eye were significantly improved from baseline to post-operative 6 week.
- The mean IOP was not significantly chnagesfrom baseline to post-operative 6 week follow-up.
- The percentage of Laceration, Rupture, Penetrating injury and Perforating open Globe injury were 10.53%, 21.05%, 47.37%, and 21.05% in right eye (OD) and 33.33%, 16.67%, 33.33%, and 16.67% in left eye (OS), respectively.
- The percentage of Lameller laceration and Contusion open close injury were 30% and 70% in right eye (OD) and 63.64%, and 36.36% in left.

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