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ANALYTIC CROSS-SECTIONAL STUDY

Association of Demographic Characteristics and Behavioral Risk with the Type and Severity of Injury of Ocular Trauma among Patients Presenting in a Provincial Level III Government Hospital: A 5-Year Analytic Cross-Sectional Study

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Abstract

Purpose: We want to determine if there is an association between demographic characteristics and behavioral risk with the type and severity of the injury of ocular trauma among patients in a level III provincial government hospital.

Methods: We did a 5-year retrospective chart review among patients who presented at the Jose B. Lingad Memorial General Hospital in the Outpatient Department, In-Patient and Emergency Room under the services of Ophthalmology, General Surgery, Otorhinolaryngology–Head and Neck Surgery, Orthopedics and Emergency Medicine.

Results: A chart review included one thousand nine hundred and ninety eyes. Most patients were 18 to 59-years-old (75.18%) and males (75.53%). The majority have a severity of OTS 5 (86.98%) and a high behavioral risk (83.22%). Working age group (18-59), elderly age group (60 and above), male gender, sharp injuries, and low behavioral risk had a significant odd of having an open globe type of injuries. Compared to the elderly age group (60 and above), workplace injuries and sharp injuries have a higher odd of severe damage (OTS 1).

Conclusions: The majority of ocular injuries are mild (OTS 5). Age, gender, mechanism of injury, zone of the globe, and behavioral risk were significant predictors of the type of injury. Keywords: ocular trauma, ocular injuries, OTS, BETTS, behavior, demographics.

Keywords

Ocular trauma, Ocular injuries, OTS, BETTS, Behavior, Demographics

Introduction

Ocular trauma encompasses any superficial or intraocular injury caused by a mechanical or chemical agent producing varying degrees of tissue damage to the eye [1]. According to the World Health Organization, ocular trauma represents a global annual incidence of 55 million, and 1.6 million people have blindness due to it, making it the most common cause of unilateral blindness worldwide [2]. It is a significant and preventable public health problem that leads to visual morbidity and permanent disability. The socioeconomic burden of ocular trauma is high and involves a considerable cost of money and anxiety and depression in the first few weeks of trauma [3]. Annually, the financial burden of ocular trauma is known to run up to thousands of pesos. Post-traumatic visual impairment can lead to profound psychological and social impacts. Ocular trauma frequently occurs in developing countries due to inadequate laws and awareness among their citizens [2,4].

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Despite their small size, the eyes are the third most common organ affected by trauma after the hands and feet. They represent 0.27% of the total body surface area and 4% of the facial area. The pattern of ocular injuries tends to vary from one location to another. Many eye injuries are due to habits and behavior patterns in certain daily activities that increase the risk for eye trauma. Corneo-scleral tear and lens damage are the most observed injuries. These were followed by the lid, canalicular laceration, periorbital hematoma, and contusion [2,4].

The Birmingham Eye Trauma Terminology System (BETTS) provided a standardized and straightforward system to describe mechanical injuries to the eye globe. A closed-globe injury is an injury without a full-thickness wound. Open-globe injury, on the other hand, has full-thickness damage. Globe rupture has a full thickness wound of the eyewall caused by blunt objects. The impact results in a transient increase of the intraocular pressure and an inside-out injury mechanism. Globe laceration has a full-thickness wound of the eyewall usually caused by a sharp object, and the impact site is an outside-in mechanism. A penetrating injury is a single laceration of the eye wall by a sharp object, and a perforating injury involves two full-thickness cuts and an entrance and exit wound [5].

Work-related eye injury in industrialized countries is between 21%-30%. Agricultural workers in developing countries risk environmental or unfavorable working conditions. Road accidents, sports injuries, and burns are the major causes of ocular trauma in any urban environment [1]. Majority of the ocular trauma patients presenting at our institution are secondary to vehicular accidents and occupation-related injuries. Vehicular accident patients are usually referred to our institution from the different primary and secondary hospitals within an 8-10-hour time frame of the trauma. An increasing relationship between motorcycle-related injury with trauma is observed. Corneal abrasion secondary to the metallic foreign body is the leading cause of morbidity in occupation-related injuries.

The Ocular Trauma Score (OTS) is a standardized system used to predict visual outcomes in patients who have obtained an open-globe eye injury which has an accuracy of 80%. OTS ranges from 1 (having the most severe eye injury and worst prognosis at six months follow up) to 5 (having the least severe injury and best prognosis at six months follow up) [6].

Research Problem

The main driving force behind the study is the limitation of baseline demographic data of patients with ocular trauma, associated behavioral risk factors, and severity of trauma sustained by using the Ocular Trauma Score (OTS) available in our country. Our institution is a trauma center that caters to end referrals from primary and secondary hospitals that need ophthalmic subspecialty services. It has ten clinical subspecialties with more than 800-bed capacities catering to patients from the different provinces across Region III.

Significance

In recent years, numerous countries have provided local data on ophthalmic trauma. These have helped create provisions and local mandates to prevent ocular trauma and increase awareness, especially among high-risk populations.

The study is a provincial pilot study to determine ocular trauma's demographic profile and circumstances in the Philippines. It could serve as a reference for future studies by providing the necessary baseline data in addition to the existing pool. It could provide information in the promulgation of new laws for preventing ocular trauma in our nation, especially in the countryside. Laws governing workplace hazards could be augmented, traffic control, and proper safety measures while on the road. The study could increase the public's awareness of the frequency of ocular trauma and, in turn, their vigilance and self-awareness.

The study was conducted in a provincial level III hospital catering to patients from the agricultural and industrialized sectors that could provide invaluable information regarding the distribution of ocular trauma in different areas. It could be a pivot for establishing a trauma database in addition to the existing published data in the country.

Review of Related Literature

Method of literature search

We used PubMed, Cochrane Library, and ScienceDirect as the search engines with keywords: profile, ocular, trauma, and demographic. Articles from American Academy of Ophthalmology, Oculofacial Plastic and Orbital Surgery 2019-2020. All related studies were limited to the English language and human studies published from 2011-2020.

Literature review

Numerous data has been published internationally regarding the demographic profile of patients with ocular trauma. Most studies associate ocular trauma with the male gender, active lifestyle, informal jobs, and certain high-risk behaviors.

In a recently published study in 2020 in Colombia, among the 146 patients included in the study, it was reported that the most significant number of traumas occurred between 25 and 34 years of age. Approximately 61% of the affected individuals resided in rural areas, and 63% had the poorest socioeconomic level. Most of the people with trauma had informal jobs and heads of households. Statistically, significant differences exist between the types of social conditions [1].

Another study published in 2010 included 132 patients from ages 1 to 70 years of age. Most of their population are males (77.3%), about 40.2% only had primary education, and 51.5% are single. Their results showed that most injuries were non-penetrating trauma (84.1%) in the workplace, and vegetative material was the most common offending agent. This study was supported by the findings of Dhasmana and colleagues, who found out that men had a two-fold higher rate of ocular injury than women. The mean age of presentation was 31.2 years (6-80 years). Their study in India, however, showed that eye-related injuries are more prevalent in road traffic accidents, and the majority are closed globe injuries. They also observed that eyes with better visual acuity at presentation had a better prognosis at six months.

In locally published data by Larona and colleagues, they reviewed 34 charts of patients who had motorcycle-related ocular injuries. They found that most active males with a lower socioeconomic income are involved. They have enumerated certain extenuating circumstances to the trauma, such as nighttime driving and alcohol use, that increased the risk for motorcycle-related ocular injuries. It is important to note that helmet use was an identifiable risk indirectly correlated with the severity of the ocular injury. This study was done in 1 year, and the exposure was limited to motorcycle-related injuries. Another city-based study done in 2020 showed that the most common objects that cause injury in the city are hammered nails among the adult population and knives at home among the pediatric population [7-12].

The anxiety and depression of the patients immediately after injury were found to be as high as 70% at baseline. This is in addition to the pain and limitation of daily activities that the patients sustain after trauma. It was reported that even at a 44% decrease in anxiety and depression after a month, patients who sustain ocular trauma do not return to the premorbid quality of life [3].

Methods

Study design

We performed a chart review of patient records in the Outpatient Department and Emergency Room of Jose B. Lingad Memorial General Hospital under Ophthalmology, General Surgery, Otorhinolaryngology-Head, and Neck Surgery, Orthopedics, and Emergency Medicine between January 1, 2017, and December 31, 2021. Data was collated using the Microsoft Excel Program devoid of the patient identifiers.

Objectives

General objective: The main objective of this study is to determine the association of demographic characteristics and behavioral risk with the type and severity of the injury of ocular trauma among patients presenting in a government hospital.

Specific objectives:

1. To identify the demographic characteristics of ocular trauma patients in a government hospital.
2. To identify the most common zone of the eye involved.
3. To associate the demographic characteristic with the type and severity of ocular trauma injury among patients in a government hospital.
4. To associate the behavioral risk with the type and severity of ocular trauma injury among patients in a government hospital.
5. To identify the incidence of the eyes who ended up having enucleation or evisceration done.
6. To identify the most common anatomic structures affected in ocular trauma.

Population

There were 4,134 patients referred, with 4,428 patients' eyes affected by our service from January 1, 2017, till December 31, 2021. Among these, 1,040 eyes only had orbital trauma, 1,182 eyes had incomplete medical records, and 216 eyes were referred 12 hours post-trauma. In the end, only 1,956 patients with 1,990 patient eyes affected were included in the analysis.

Data collection

The medical records were selected by cross-referencing the different types of ocular trauma presented in the other services. For each patient, the data collected include age, gender, circumstances of trauma which consists of the place of occurrence, mechanism of injury, object causing the injury, anatomic structure affected by the trauma, and the Ocular Trauma Score. Ocular injuries were categorized according to Birmingham Eye Trauma Terminology (BETT), and Ocular Trauma Scores will be calculated for each patient. We utilized the OTS for both open and closed-globe injuries in the study.

After collection, the data were compiled in a Microsoft Office Excel file, and the charts were assigned with a number according to their date of presentation at our institution. The other data were set with a numeric value for processing.

Data processing and analysis

Data were encoded and tallied in SPSS version 23 for windows. We computed the descriptive statistics for all variables for nominal data frequencies and percentages. For numerical data, mean ± SD was generated. The different variables were analyzed using the following test statistics: T-test or Mann-Whitney U test as needed for comparing two groups with numerical data. The Chi-square test was used to compare/associate nominal

(categorical) data. Multiple logistic regression with backward elimination technique was used to identify variables associated with open globe injury. The point and 95% confidence interval of the odds ratio derived from the logistic regression analysis were reported. All variables with p </= 0.05 were considered statistically significant.

The population was assigned into different groups per variable. Following age, the population was divided into pediatric (0-17 years-old), working-age group (18-59 years-old), and geriatric (60 and above years old). Sorting according to gender was also done. The BETTS criteria defined the type of injury into open and closed globe injuries. The object causing damage was divided into five subgroups which are shrapnel (non-organic), a vehicular motor crash, organic (insects), wood (plant materials), and mauling. *Zones* of the globe are defined as Zone 1, which includes the cornea and structures behind it. Zone 2 has a 5 mm gap between the limbus and the sclera. Zone 3 provides for the rest of the sclera and conjunctiva. The mechanism of injury was divided into three subgroups, blunt injuries, projectile injuries (any object with velocity hitting the eye), and sharp injuries (including stabbing and poking injuries). The severity of the injury was calculated based on the OTS. The behavioral risk factors were defined as follows, high risk were eyes sustaining injury due to lack of proper eye protective equipment in cases of workplace injuries, lack of helmet during motorcycle driving, driving under the influence of alcohol, unsupervised child's play, and intent to cause harm in cases of mauling and other blunt injuries (verified as Medico-legal cases). Low risk includes chance victims in vehicular crashes (MVC) such as pedestrians, supervised child's play, and accidents, especially in cases of the elderly. Finally, the place of injury was divided into home, public place (which includes vehicular motor crashes), and workplace.

Results

There were 1,990 patients in the study from 2017 to 2021- 219 in 2017, 267 in 2018, 474 in 2019, 497 in 2020, and 533 in 2021. Table 1 shows the demographic characteristics of ocular trauma patients. Most patients were 18 to 59-years-old (75.18%) and males (75.53%). Around 95% have closed globe type of injury, with the projectile as the mechanism of injury in more than half of the patients (52.06%). The most common object causing damage is shrapnel (49.15%), followed by MVC (25.18%) and mauling (14.57%). In terms of the zone of the globe, 63.22% were in zone 1, 32.26% were in zones 2, and 4.52% were in zone 3. Around 55% had the injury in a public place, and 36% were from the workplace. Most patients have a severity of OTS 5 (86.98%) and a high behavioral risk (83.22%).

Table 2 demonstrates the association of demographic characteristics and type of injury of ocular trauma. From the results, age and gender were not associated with the type of injury. On the other hand,

Table 1: Demographic Characteristics of Ocular Trauma Patients.

Characteristic	Frequency	Percentage	Characteristic	Frequency	Percentage
Age			**Mechanism**		
0 – 17	354	17.79	Blunt	884	44.42
18 – 59	1496	75.18	Projectile	1036	52.06
60 and above	140	7.04	Sharp	70	3.52
Gender			**Type**		
Male	1503	75.53	Open globe	105	5.28
Female	487	24.47	Closed globe	1885	94.72
Object			**Severity**		
Shrapnel	987	49.15	OTS 1	52	2.61
MVC	501	25.18	OTS 2	11	0.55
Organic	178	8.94	OTS 3	50	2.51
Wood	43	2.16	OTS 4	146	7.34
Mauling	290	14.57	OTS 5	1731	86.98
Zone of the Globe			**Place**		
Zone 1	1258	63.22	Home	175	8.79
Zone 2	642	32.26	Public place	1098	55.18
Zone 3	90	4.52	Workplace	717	36.03
Behavioral Risk					
High Risk	1656	83.22			
Low Risk	334	16.78			

*Count is by number of eyes involved

Table 2: Association of the Demographic Characteristics with the Type of Injury of Ocular Trauma.

	Open Globe (n=105)	Closed Globe (n=1885)	p-value
Age			0.378
0 – 17	24 (22.86%)	330 (17.51%)	
18 – 59	74 (70.48%)	1422 (75.44%)	
60 and above	7 (6.67%)	133 (7.06%)	
Gender			0.591
Male	77 (73.33%)	1426 (75.65%)	
Female	28 (26.67%)	459 (24.35%)	
Mechanism			<0.001*
Blunt	14 (13.33%)	870 (46.15%)	
Projectile	49 (46.67%)	987 (52.36%)	
Sharp	42 (40.00%)	28 (1.49%)	
Object			<0.001*
Shrapnel	64 (60.95%)	914 (48.49%)	
MVC	3 (2.86%)	498 (26.42%)	
Organic	6 (5.71%)	172 (9.12%)	
Wood	23 (21.90%)	20 (1.06%)	
Mauling	9 (8.57%)	281 (14.91%)	
Zone of the Globe			<0.001*
Zone 1	99 (94.29%)	1159 (61.49%)	
Zone 2	6 (5.71%)	636 (33.74%)	
Zone 3	0 (0.00%)	90 (4.77%)	
Place			<0.001*
Home	28 (26.67%)	147 (7.80%)	
Public place	33 (31.43%)	1065 (56.50%)	
Workplace	44 (41.90%)	673 (35.70%)	

*Significant at 0.05 level

Table 3: Association of Behavioral Risk with the Type of Injury of Ocular Trauma.

	Open Globe (n=105)	Closed Globe (n=1885)	p-value
Behavioral Risk			<0.001*
High Risk	64 (60.95%)	1592 (84.46%)	
Low Risk	41 (39.05%)	293 (15.54%)	

*Significant at 0.05 level

the mechanism of injury, object causing damage, zone of the globe, and place where the injury was obtained were associated with the type of injury (p-values equal to < 0.001). The majority of the open globe injuries were sharp and projectile, while the majority of the closed globe injuries were blunt and projectile. Moreover, most of the open globe was from shrapnel and wood, while most of the closed globe was from shrapnel and MVC. Regarding zone, 94% were in zone 1 in the open globe, while only 61% were in zone 1 in the closed globe. Lastly, in terms of place of injury, most of the injuries were sustained in the workplace among open globe injuries (42.90%) and in the public place among closed globe injuries (56.50%).

The association of behavioral risk with the type of injury is shown in Table 3. Results also showed that behavioral risk is associated with the type of injury of ocular trauma (p = < 0.001). For both damages, the majority of them are high risk.

The association of the demographic characteristics and the injury severity was also assessed. All variables such as age (p = < 0.001), gender (p = 0.002), mechanism of injury (p = < 0.001), object causing damage (p = < 0.001), zone of the globe (p = < 0.001), and place (p = < 0.001) were significantly associated with the severity of the injury. Similar percentages of age groups were similar in all groups of severity except for OTS 4, where

Table 4: Association of the Demographic Characteristics with the Severity of Injury of Ocular Trauma.

	OTS 5 (n=1731)	OTS 4 (n=146)	OTS 3 (n=50)	OTS 2 (n=11)	OTS 1 (n=52)	p-value
Age						<0.001*
0 – 17	291 (16.81%)	35 (23.97%)	16 (32.00%)	4 (36.36%)	8 (15.38%)	
18 – 59	1362 (78.68%)	57 (39.04%)	32 (64.00%)	7 (63.64%)	38 (73.08%)	
60 and above	78 (4.51%)	54 (36.99%)	2 (4.00%)	0 (0.00%)	6 (11.54%)	
Gender						0.002*
Male	1310 (75.68%)	111 (76.03%)	27 (54.00%)	9 (81.82%)	46 (88.46%)	
Female	421 (24.32%)	35 (23.97%)	23 (46.00%)	2 (18.18%)	6 (11.54%)	
Mechanism						<0.001*
Blunt	777 (44.89%)	88 (60.27%)	6 (12.00%)	0 (0.00%)	13 (25.00%)	
Projectile	937 (54.13%)	49 (33.56%)	26 (52.00%)	5 (45.45%)	19 (36.54%)	
Sharp	17 (0.98%)	9 (6.16%)	18 (36.00%)	6 (54.55%)	20 (38.46%)	
Object						<0.001*
Shrapnel	870 (50.26%)	40 (27.40%)	31 (62.00%)	10 (90.91%)	27 (51.92%)	
MVC	441 (25.48%)	56 (38.26%)	1 (2.00%)	0 (0.00%)	3 (5.77%)	
Organic	157 (9.07%)	14 (9.59%)	3 (6.00%)	0 (0.00%)	4 (7.69%)	
Wood	14 (0.81%)	4 (2.74%)	14 (28.00%)	1 (9.09%)	10 (19.23%)	
Mauling	249 (14.38%)	32 (21.92%)	1 (2.00%)	0 (0.00%)	8 (15.38%)	
Zone of the Globe						<0.001*
Zone 1	1086 (62.74%)	70 (47.95%)	44 (88.00%)	11 (100.00)	47 (90.38%)	
Zone 2	572 (33.04%)	60 (41.10%)	5 (10.00%)	0 (0.00%)	5 (9.62%)	
Zone 3	73 (4.22%)	16 (10.96%)	1 (2.00%)	0 (0.00%)	0 (0.00%)	
Place						<0.001*
Home	118 (6.82%)	26 (17.81%)	17 (34.00%)	4 (36.36%)	10 (19.23%)	
Public place	952 (55.00%)	109 (74.66%)	27 (54.00%)	1 (9.09%)	9 (17.31%)	
Workplace	661 (38.19%)	11 (7.53%)	6 (12.00%)	6 (54.55%)	33 (63.46%)	

*Significant at 0.05 level

Table 5: Association of Behavioral Risk with the Severity of Injury of Ocular Trauma.

	OTS 5 (n=1731)	OTS 4 (n=146)	OTS 3 (n=50)	OTS 2 (n=11)	OTS 1 (n=52)	p-value
Behavioral Risk						<0.001*
High Risk	1473 (85.10%)	115 (78.77%)	20 (40.00%)	7 (63.64%)	41 (78.85%)	
Low Risk	258 (14.90%)	31 (21.23%)	30 (60.00%)	4 (36.36%)	11 (21.15%)	

*Significant at 0.05 level

the ages 18 to 59 only comprised 39.04%, and those above 60 comprised 36.99% of the group. Regarding gender, OTS 3 has a different pattern, with only 54% of males. Each severity group has another distribution regarding the mechanism of injury, object causing damage, and place. When looking at the distribution of the zones, a large percentage were in zone 1 in groups OTS 3, OTS 2, and OTS 1, while only 62.74% were in zone 1 in OTS 5, and only 47.95% were in this zone in OTS 4 (Table 4).

Presented in Table 5 is the association between the severity of the injury and behavioral risk. There is also a significant association between these variables (p = < 0.001). Most were high risk in all groups except for OTS 3, where 60% had low behavioral risk.

The multivariate analysis of the association of the demographic variables with the type of injury using logistic regression is shown in Table 6. Age, gender, mechanism of injury, zone of the globe, and behavioral risk were significant predictors of the type of injury (p-values less than 0.05). Those 18 to 59-years-old and more than 60-years-old have 3.32- and 4.59-times greater odds of having an open globe than those 0 to 17-years-old. Moreover, having a sharp mechanism of injury has 28.05 times greater odds of having an open globe than a blunt mechanism, and low behavioral risk

Table 6: Multivariate Analysis on the Association of Demographic Characteristics with the Type of Injury of Ocular Trauma.

Variable	OR	95% CI	p-value
Age			
0 – 17	(base)		
18 – 59	3.32	1.59 – 692	0.001*
60 and above	4.59	1.63 – 12.88	0.004*
Gender			
Male	(base)		
Female	0.30	0.15 – 0.61	0.001*
Mechanism			
Blunt	(base)		
Projectile	0.72	0.34 – 1.52	0.389
Sharp	28.05	12.06 – 65.23	<0.001*
Zone of the Globe			
Zone 1	(base)		
Zone 2	0.14	0.50 – 0.39	<0.001*
Zone 3	-	-	-
Behavioral Risk			
High Risk	(base)		
Low Risk	4.93	2.50 – 9.75	<0.001*

*Significant at 0.05 level

Table 7: Multivariate Analysis on the Association of Demographic Characteristics with the The severity of Injury of Ocular Trauma (OTS 5 vs. OTS 1).

	Variable	OR	95% CI	p-value
OTS 5	**(base outcome)**			
OTS 1				
	Age			
	0 – 17	(base)		
	18 – 59	2.26	0.58 – 8.46	0.244
	60 and above	12.45	2.99 – 51.90	0.001*
	Place			
	Home	(base)		
	Public place	0.42	0.12 – 1.50	0.180
	Workplace	13.72	2.78 – 67.78	0.001*
	Mechanism			
	Blunt	(base)		
	Projectile	0.17	0.03 – 0.81	0.026*
	Sharp	29.49	4.67 – 186.19	<0.001*
	Object			
	Shrapnel	(base)		
	MVC	3.57	0.40 – 31.93	0.245
	Organic	9.42	2.09 – 42.43	0.003*
	Wood	6.83	1.23 – 38.01	0.028*
	Mauling	9.96	1.36 – 73.05	0.024*
	Zone of the Globe			
	Zone 1	(base)		
	Zone 2	0.17	0.05 – 0.56	0.004*
	Zone 3	1.30e-07	-	0.993

*Significant at 0.05 level

has 4.93 times greater odds of having an open globe compared with those with high risk.

Those groups with an odds ratio (OR) less than 1, such as being female, having projectile as a mechanism of injury, and having zone 2 as the zone of the globe, were associated with a decrease in odds of having an open globe type of injury.

The multivariate analysis of the association of the demographic variables with the severity of injury using multinomial logistic regression is presented in Table 7, Table 8 and Table 9. Each OTS group was compared to the base outcome, OTS 5. Table 7 shows the results for OTS 1 vs. OTS 5. The significant predictors for this model were age, place, mechanism of injury, object-causing

Table 8: Multivariate Analysis on the Association of Demographic Characteristics with the Severity of Injury of Ocular Trauma (OTS 5 vs. OTS 3).

	Variable	OR	95% CI	p-value
OTS 5	**(base outcome)**			
OTS 3				
	Age			
	0 – 17	(base)		
	18 – 59	3.64	1.49 – 8.90	0.005*
	60 and above	2.00	0.39 – 10.25	0.406
	Place			
	Home	(base)		
	Public place	0.38	0.15 – 0.96	0.041*
	Workplace	0.02	0.01 – 0.08	<0.001*
	Mechanism of Injury			
	Blunt	(base)		
	Projectile	1.24	0.27 – 5.81	0.784
	Sharp	6.54	1.16 – 37.02	0.034*
	Object causing Injury			
	Shrapnel	(base)		
	MVC	0.02	0.002- 0.22	0.002*
	Organic	0.15	0.04 – 0.52	0.002*
	Wood	2.74	0.92 – 8.15	0.071
	Mauling	0.04	0.004- 0.43	0.007*

*Significant at 0.05 level

Table 9: Multivariate Analysis on the Association of Demographic Characteristics with the Severity of Injury of Ocular Trauma (OTS 5 vs. OTS 3).

	Variable	OR	95% CI	p-value
OTS 5	**(base outcome)**			
OTS 4				
	Age			
	0 – 17	(base)		
	18 – 59	0.54	0.32 – 0.91	0.020*
	60 and above	7.08	4.17 – 12.01	<0.001*
	Place			
	Home	(base)		
	Public place	0.99	0.55 – 1.80	0.985
	Workplace	0.22	0.08 0 0.58	0.002*
	Mechanism			
	Blunt	(base)		
	Projectile	3.35	1.05 – 10.76	0.042*

Sharp	25.20	5.60 – 113.40	<0.001*
Object			
Shrapnel	(base)		
MVC	3.77	1.23 – 11.60	0.020*
Organic	0.67	0.32 – 1.41	0.297
Wood	0.61	0.14 – 2.71	0.517
Mauling	3.48	1.10 – 11.04	0.034*

*Significant at 0.05 level

Table 10: Total Number of Eyes who ended up having Enucleation and Evisceration done.

Enucleation	11
Evisceration	0

Table 11: Total Number of injuries per anatomic structure involvement.

Cornea	1,129
Conjunctiva	896
Sclera	23
Anterior Chamber	139
Iris	63
Lens	58
Vitreous	13
Retina	4
Optic Nerve	96

injury, and zone of the globe. Those 60-years-old and above have 12.45 times greater odds of having OTS 1 than OTS 5 than those 0-17 years-old. Those in the workplace have 13.72 times greater odds of having OTS 1 than those who had an injury from home. Those with sharp mechanisms have 29.49 higher odds of having OTS 1 than OTS 5, and organic, wood, and mauling causing injury also to have higher odds of having OTS 1 than shrapnel. On the other hand, the projectile mechanism of injury and having an injury in zone 2 have decreased the odds of having OTS 1. No significant predictors were observed when OTS 2 was compared with OTS 5.

Table 8 shows the multivariate analysis of OTS 3 vs. OTS 5. In this model, age, place, mechanism of injury, and object-causing injury were significant predictors. Those 18 to 59-years-old were 3.64 times more likely to have OTS 3 than OTS 5 compared with 0-17 years-old. A sharp mechanism also has increased odds (OR = 6.54) of having OTS 3. On the other hand, getting the injury from a public place and workplace and having MVC, organic, or mauling as an object causing damage is associated with decreased odds of having OTS 3 severity.

Shown in Table 9 is the multivariate analysis of the association of demographic characteristics with the severity of the injury, OTS 4 vs. OTS 5. The same variables as with OTS 3 vs. OTS 5 were significant predictors. Those 60-years-old and above have increased odds of having OTS 4, while those 18 to 59 have decreased odds of having OTS 4. Having sharp and projectile mechanisms and MVC and mauling as objects causing injury has a greater odd of having OTS 4 than their base or reference category. Meanwhile, having a workplace as the place where the injury occurred has decreased the odds of having OTS 4.

Eleven patients with open globe injuries who ended up having enucleation were reported in the study, while 0 patients had evisceration done. Six patients' eyes suffered from projectiles (4 metallics and two glass materials) hitting the globe from blast injuries, while five patients had shrapnel penetrating the eyes in cases of MVC.

The cornea is the most affected part of the eye in ocular injuries, followed by the conjunctiva and the anterior chamber. One thousand and one hundred and twenty-nine eyes were recorded to sustain corneal injuries, and 896 eyes had a conjunctival injury involved. Seven hundred eighty-seven with a corneal injury suffered from projectile injury resulting to corneal foreign body and subsequent primary removal with a low severity (OTS 5). This was followed by 669 patients who suffered from subconjunctival hemorrhage from mauling and MVC (Table 10 and Table 11).

Discussion

This study showed that most ocular trauma is associated with high-risk behavior and a good visual prognosis (OTS 5). Severe ocular injuries (OTS 1) were also reported, where 11 eyes were subjected to enucleation.

Age

Based on the results, the patient's age is not associated with any specific type of injury. While most patients that sustained ocular injury from the 5-year study were 18-59 years-old, the type of ocular trauma (open versus closed globe) is statistically insignificant in frequency in all age groups with a p-value of 0.378. This means that the patient's age is not associated with the type of injury. The severity of injury (estimated with the OTS) is higher in the age group of 18-59 years-old, with a total of 38 eyes involved (73.08%). The distribution frequency in the different age groups may be confounded by pre-existing eye conditions, especially in the groups of 18-59 and 60 and above, such as cataracts, retinopathy from systemic diseases, and

refractive error were not included in the study analysis. There is a similar distribution frequency in patients 0-17 years-old, which may be confounded by the lack of attention and cooperation, especially in children below the age of 5.

Gender

Same with the age analysis, the gender of the patient is not associated with any specific type of injury. While most patients that sustained ocular injury are male in both open and closed globe types, the injury frequency is not statistically significant in both genders, with a p value of 0.591. The results mean that regardless of the gender of the patient, open and closed globe occurs with the same frequency. The male population is significantly affected by trauma compared to the female population. The results show a higher distribution among the OTS in the male gender. The distribution of OTS across both genders is almost equal in frequency, which may have been confounded by the different scenarios reported in the previous paragraph.

Mechanism and object causing the injury

The relationship of open globe injuries with projectile and sharp injuries was noted to be significant, consistent with literature that most of these injuries lead to total thickness corneal lacerations, scleral lacerations, and globe ruptures. Injuries encountered at our institution with an open globe type of injury are primarily due to penetrating or perforating injuries from shattered glass or metal, whiplash of plant materials in farmers, and debris from vehicular crashes, all of which have a projectile nature. Stabbing and ocular impalement injuries are also typical; using ice picks and sharpened wood such as a pencil or a stick increases the frequency of sharp injuries. Projectile injuries from industrial sectors comprise most closed globe injuries. These include corneal foreign bodies sustained from grinder and construction work without proper protective eye goggles and corneal or conjunctival foreign bodies from patients riding motorcycles without good helmet use. The second most common injuries are traumatic iritis and subconjunctival hemorrhage, which are examples of blunt injuries. These are obtained by patients who are usually under the influence of alcohol at the presentation from vehicular accidents and physical altercations. Projectile injuries from shrapnel, organic, and wood injuries comprise more than half of the OTS 5 because these are from eyes that suffer from foreign bodies in the cornea that can be removed and usually heals very well. While OTS 1 has an almost equal distribution because of the small population that suffered very severe injuries regardless of the nature of trauma.

Zone of the globe

The most commonly affected anatomic structure in ocular trauma is the cornea, adjacent conjunctiva, and the anterior chamber, which comprises zone 1 of the globe. In open globe types of injury, zone 1 has a significant frequency of 94.29% and 61.49% in closed globe types of injuries. This result is expected due to the nature of open globe types of damages commonly encountered at our institution, such as stabbing or ocular impalement, penetrating or perforating injuries from projectiles, and in occasional instances, severe beating or mauling. The zone of the globe that is mainly affected regardless of the OTS is Zone 1 because of its most anterior placement in the anatomy, which is easily affected irrespective of the type of trauma.

Place of injury

Finally, the workplace is the most common place where open globe injuries occur. Most eyes suffer from penetrating or perforating injuries from blast trauma, causing projectiles that hit the eyes in industrial and construction workplaces (projectile and sharp injuries from blast trauma). Closed globe injuries are frequently encountered in public spaces due to foreign bodies attained while driving without proper helmet use, mauling from altercations, and play time accidents in children and their playmates. Most severe injuries (OTS 1) occur in the workplace and have a higher distribution than in other familiar places of trauma.

Behavioral risk

Open (60.95%) and closed globe injuries (84.46%) are both higher in patients who exhibit an increased risk of behavior in their activities such as driving motor vehicles, especially motorcycles, without the proper use of a protective helmet or driving under the influence of alcohol (382 patient eyes of 19.20%), physical altercations, construction or industrial work such as the use of grinder without proper eye protection and unsupervised playtime of children. The remaining subset of open globe injuries with low-risk factors are eyes who suffered from accidents such as pedestrian versus driver in vehicular crashes, blast injuries with a subsequent shattering of goggles, fall in the elderly, and patients who are passerby in cases of stabbing from strangers. The remaining subset of closed globe injuries comprised pedestrians or patients in their home where an insect crawls in their eye, accidental mauling by people beside them, and fall in the elderly and children who sustain ocular trauma in the presence of a supervising adult. The severity of high-risk behavior is almost equally distributed. This may be because of the diverse nature of trauma that an individual can attain.

Age, gender, mechanism of injury, zone of the globe, and behavioral risk were significant predictors of the type of injury (p-value less than 0.05). Being in the adult age group (18 and above) has a 3.32 (18-59 years-old) and 4.59 (60 and above) more significant chance of obtaining open globe injuries. These may be due to the different exposures that an adult might have in cases of

work and activities as compared to children. Moreover, sharp injuries and a lower behavioral risk have higher odds of obtaining an open globe type of injury than a closed type. This can be explained by the sheer number of chance victims of mauling, stabbing, penetrating, and perforating types of damage that are affected in our institution.

Enucleations are done for significantly painful and blind eyes, and in this setting, mostly from sustained open globe injuries. Our institution's primary repair and globe salvage is the main intent for open globe injuries despite poor baseline visual acuities. No eyes underwent primary evisceration in this subset of data, most likely from sustained scleral compromise, which is a prerequisite for this type of surgery).

Conversely, ocular trauma is more common in ages 18-59 (75.18%) and males (75.53%). The most occurrence of ocular trauma is in public places (55.18%), with projectile injuries (52.06%) coming from shrapnel (49.15%). The most common type of ocular trauma is a closed globe injury (94.72%) affecting Zone 1 (63.22%) of the globe with a mild severity (OTS 5) (86.98%). The study population involved exhibits a high-risk behavior (83.22%). Age and gender were not associated with the type of injury. Most open globe injuries were sharp (40%) and projectile (46.67%). In comparison, most closed globe injuries were blunt (46.15%) and projectile (52.36%). Around 85% were at high risk in the closed globe group, and 61% were at high risk in the open globe group. Age, gender, mechanism of injury, zone of the globe, and behavioral risk were significant predictors of the type of injury (genuine globe). The odds of having an OTS 1 compared with an OTS 5 are higher in old age (OR 12.45), workplace injuries (OR 13.72), sharp injuries (OR 29.49), organic (OR 9.42) and wood objects (OR 6.83), and mauling (OR 9.96). The odds of having an OTS 3 compared with an OTS 5 are higher in adults (18-59 years-old, OR 3.64, 60 and above, OR 2.00) and in sharp injuries (OR 6.54). The odds of having an OTS 4 compared with an OTS 5 are higher in old age (OR 7.08), projectile (OR 3.35), sharp injuries (OR 25.20), and in cases of mauling (OR 3.48) and MVC (OR 3.77).

Limitations

The study is limited to available data from charts compiled from January 1, 2017, to December 31, 2021. There were only 1,990 patient eyes included in this study due to incomplete medical records and timing of referral to our service. The population is limited to the middle to lower socioeconomic status and does not encompass the different trauma seen in a private institution. Ocular trauma was the only Ophthalmologic disease considered in this study. Other coexisting Ophthalmologic conditions were not considered and thus may affect the severity score. Only the two main categories of the BETTS classification were included in the study. The association between the type of injury and the severity of the injury was not done. Primary enucleation and evisceration were the ones considered in the study due to the nature of the chart review and the inclusion of patient follow-up.

Conclusion

Trauma has a very diverse nature. It can occur anywhere and to anyone regardless of age, gender, or associated behavior. In this study, we identified predictive factors and conditions where the trauma of different severities can occur to a specific individual. Our data shows it most commonly affects working-age men with a high risk of behavior. The Philippines has existing guidelines on eye protection in the workplace. However, a review of ground data shows that most of these employees do not observe strict compliance with these protocols. Most patients who sustained severe ocular injuries from vehicular motor crashes failed to wear protective helmets or were under alcohol. Laws are in place to prevent these accidents; however, implementation and enforcement appear to be lacking. Despite the nature of an ocular trauma that an individual may encounter, it can cause a significant economic burden in a developing country. These burdens may range from unnecessary expenditure from a preventable cause to loss of jobs due to permanent disability. Trauma is a significant and preventable public health concern that could quickly be addressed with proper commitment and adherence to the guidelines that are currently in place.

Recommendations

A prospective study may be done to observe if there is a shift in trends like ocular trauma, especially in establishing an Orbital and Ocular Trauma database in our institution. Including patient, follow-up may show an increase in the enucleation and evisceration done following ocular trauma. A study of orbital trauma, including eyelids and orbital fractures, may be done, especially in blunt injuries. Co-existing Ophthalmologic diseases may be considered in future studies to classify the severity of trauma further.

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Declaration of Interest

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