Original article

A Prospective Study on the Medicolegal Aspects of Traumatic Eye Injuries in Upper Egypt and Their Outcomes

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ABSTRACT

Background: Ocular injuries are more common in underdeveloped nations and a preventable cause of blindness and monocular vision impairment. The effects of sight loss brought on by occupational ocular injuries have a direct and indirect impact on employees' and their families' futures, on social interaction, and on the growth and prosperity of the nations. **Objectives:** The present study aimed to evaluate the medicolegal aspects of eye trauma cases presented to Sohag University Hospitals; and to determine if early diagnosis and intervention will affect patient outcome and occurrence of permanent infirmity or not. **Methods:** The present study was performed as a prospective cross-sectional study during the period (from 1st of January 2022 to 30th of June 2022) involving 405 individuals who attended Sohag University Hospitals. The visual acuity of all injured cases was measured after complete recovery using Landolt C chart. **Results:** Most of cases were under the age of 18 years with male predominance. Wooden and plant objects were the leading causes of most cases; followed by kitchen tools then and metal objects. The most common closed globe injuries were caused by foreign body, corneal abrasion. While penetrating injuries were the most common open globe injuries. **Conclusion:** Cases who presented earlier in less than 6 hours had final VA (visual acuity) better compared with those who presented after more than one day. Complicated cases of global rupture had poor visual acuity than the others. Cases that received treatment early and followed up regularly had better outcome than delayed cases or cases that neglected regular follow up.

Key words: Manner of eye injury, visual acuity, permanent infirmity, outcomes of ocular trauma.

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I. INTRODUCTION

Ocular trauma is described as an injury to the eyeball and ocular adnexa caused by mechanical, electrical, thermal or chemical force (Scott, 2011 and Espinosa et al., 2021).It is a leading cause of blindness and vision impairment worldwide, posing a significant socioeconomic burden (Guo et al., 2021).

According to estimates, 90 percent of eye damage can be avoided (Beshay et al., 2017).

Advance age, poor initial visual acuity, type and amount of ocular damage, globe rupture, presence of vitreous haemorrhage and retinal detachment, displacement of the crystalline lens, and the requirement for repeated ocular procedures have all been observed to alter the prognosis of ocular globe injuries (Fujikawa et al., 2018).

Eye injuries can be classified as either open globe injuries or closed globe injuries, according to The Birmingham Eye Trauma Terminology (BETT). Open globe injuries are further classified into rupture, which is defined as "a full-thickness wound of the eye wall by a blunt object," and laceration, which includes intraocular foreign bodies, penetrating injury (entry wound only), and perforation (entrance and exit wounds). A partial-thickness wound of the eye wall is referred to as a lamellar laceration and a blow to the eye wall that results in a partial-thickness wound is referred to as a contusion (Kuhn et al., 2002).

Causes of ocular injuries vary according to the patient's age and occupation. One study observed a peak incidence of open globe injuries in teenagers and young adults (Choovuthayakorn et al., 2020). Ocular trauma is primarily caused by work-related accidents in both developing and developed nations (Limbu et al., 2018). The most common causes of eye injuries in children are blunt or sharp objects, such as household furniture corners, balls, gilis, toys and wooden sticks (Patil et al., 2022). The incidence and mechanism of eye trauma appear to be influenced by socioeconomic status as well, with lower socioeconomic groups being at greater risk. The risk of eye injuries is lower in literate people (Khatry et al., 2004).

Foreign bodies (FBs) are categorized as extra ocular (EOFB), intra ocular (IOFB), intramural foreign bodies (IMFB), which are lodged inside the layers of cornea or sclera and are neither IOFB nor EOFB, and adnexal foreign bodies (orbit, eyelids, conjunctiva and lacrimal system) (Shukla, 2016).

Age, the size of the wound, the duration of time between the injury and repair, the size of the FB and complications such endophthalmitis and retinal detachment all affect the visual prognosis (Liu et al., 2019). IOFB injuries are less common in people wearing eye protection; therefore, the usage of protective glasses should be recommended for susceptible people (Casini et al., 2021).

Eyelid injuries, such as contusions, eyelid lacerations, traumatic ptosis, canalicular lacerations, cicatricial ectropion, medial canthus deformity and others, are common sequelae of severe trauma caused by blunt or sharp items (Kuhn et al., 2002). The depth and location of the damage determine the course of treatment for a lid laceration (Anuradha et al., 2019).

In the absence of accompanying injury, traumatic hyphema (Blood entering the anterior chamber) is typically a self-limiting condition that rarely results in permanent loss of vision (Gharaibeh et al., 2019).

Raccoon eye, also known as periorbital ecchymosis, is a common symptom following traumatic injuries to the head and neck. It is caused by blood tracking into periorbital tissues (Somasundaram et al., 2014).The most prevalent presenting

symptoms of blunt trauma are ecchymosis and edema (AlMahmoud et al., 2019).
Corneal abrasion is the most frequent ocular injury (Go et al., 2019).
When injuries were restricted to the eyelid or adnexa, the final visual prognosis was better compared to both open and closed globe injuries (Choovuthayakorn et al., 2020), but injuries to retina had a worse prognostic result than others (Fujikawa et al. ,2018).

The present study aimed to evaluate the medicolegal aspects of eye trauma cases presented to Sohag University Hospitals; and to determine if early diagnosis and intervention will affect patient outcome and occurrence of permanent infirmity or not.

II. Patients and Methods

The present study was performed as a prospective cross-sectional study during the period (from 1st of January 2022 to 30th of June 2022) involving 405 individuals who attended Sohag University Hospitals.

Patients:

Inclusion criteria: All diagnosed cases of eye trauma, irrespective of gender, laterality, duration of presentation

Exclusion criteria: Patients with previous history of eye trauma or other pathological condition affecting visual acuity (glaucoma, cataract ….).

Ethical consideration:

This study was conducted after approval of the Ethical Committee of Faculty of Medicine, Sohag University. This study was registered at Clinical Trials.gov. It followed the tenets of the Declaration of Helsinki. Patients' individual signed informed consent was obtained from the patient or his/her guardian (if below 18 years old) after the procedure and study's goal were explained to them.

Methods of the study:

Data were collected through the attached sheet (annex- 1) and then was coded and analyzed using the SPSS software.

Data included:

1. Age
2. Sex: (male/ female)
3. Residence:(urban / rural)
4. Governorate
5. Occupation:(worker/ not working/ student)
6. Circumstances (assault, quarrels, during playing, occupational hazards or traffic accidents)
7. Injury scene
8. Manner of injury: (accidental/ homicidal)
9. Offender in case of homicidal manner
10. Cause of ocular trauma
11. Causative instrument
12. Site of injury (right eye / left eye / both eyes)
13. Delay time between injury and hospital arrival
14. Type and pattern of injury
15. Associated with other injury or not (mention)
16. Investigations
17. Past history
18. Conservative treatment
19. Surgical treatment
20. Expected time for recovery: (less than 20 days / more than 20 days)
21. Duration of hospital stay
22. Possibility of permanent infirmity
23. Outcome
24. Visual acuity after recovery according to Abdellah et al. (2022)

    Level 1 = good visual acuity, defined as 6/36 or higher

Level 2 = moderate visual acuity from 6/60 to 1/60
Level 3 = poor visual acuity, VA 1/60, hand movement or light perception
Level 4 = blind eye (no perception of light)

25. Need for further intervention
26. Recommendations

Instruments

The patients were assessed by the following instruments:

1. Slit lamp.
2. Landolt C chart.
3. Auto refractometer.
4. B scan ocular ultrasound.
5. Direct ophthalmoscope.
6. Indirect ophthalmoscope.
7. CT of the orbit.

Statistical analysis

Sample size was calculated by OpenEpi program, version 3 open source calculator - SSCC by using cross-sectional study equation by Kelsey et al. (1996).

Data of the cases were collected and recorded in sheets then all data were analyzed in Statistical Package for the Social Sciences (SPSS) computer program version 23 (IPM SPSS statistics 23) and expressed in tables and figures. The Quantitative data was tested for normality by Kolmogorov-Smirnov then was represented in mean and standard deviation if normal and in median and interquartile if non-parametric. Nominal data were expressed in number and percentages. The chi square test and P value were used to analyze the data. In all analyses, P value <0.05 indicated statistical significance.

III. RESULTS

As regard to the sociodemographic data: **(Table1)**

The age of injured patients ranged from 6 months to 65 years. The cases were classified into five age groups. Most cases were less than 18 years. The male patients represented 73.3 % of cases in comparison to female patients who were only 26.7 % of cases. 50.4 % of the involved cases lived in rural area and urban residence represented 49.6 % of cases**.** The majority of cases were from Sohag (85.9 % of cases)**.** Students represented 48.9 %, not working cases represented about 30.4 % of cases, and workers represented 20.7 % of cases.

As regard to medico legal data:

Regarding the circumstances; 18.3% of cases were injured during work, 5.2% of cases were due to quarrels; traffic accidents represented 4.7% of cases, the remaining (71.9% of cases) were injured accidently by other circumstances **(Table 2).** As regard to injury scene; the majority of cases (60.7%) occurred in the street or playground, 22.5 % of cases occurred at home and 16.8% of cases occurred in work place **(Table 3)** and according to the manner of injury; the highest incidence of cases was accidental 94.8 % of cases and only 5.2 % of cases were homicidal **(Table 4).** In which the offender in 8 cases were neighbors while strangers were the offender in 6 cases, friends were the offender in 5 cases and family members were the offender in 2 cases **(Table 5).** As regard to the causative instrument; Penetrating objects were the most common type; accounting for 60.2 % of total cases (specially stick or tree branches which caused 99 cases of ocular trauma), followed by blunt objects (27.2%) then

sharp objects (11.1%) , the remaining 6 cases were unknown as the kid 's mother couldn't identify the cause of trauma**(Table 6).**

As regard to the site of eye injury in which left eye represented 48.4% of cases while right eye represented 46.9 % of cases and both eyes only 4.7 % of cases **(Table 7)**.

As regard to delay time between injury and hospital arrival in which 74.8 % of cases arrived in less than 6 hours, 3.7 % of cases arrived from 6 to less than 24 hours after injury, 19.8 % of cases arrived from 1 day to less than 7 days after injury and 1.7 % of cases came after more than 1 week from injury **(Table 8).**

As regard to types of ocular injury after trauma closed globe injuries (CGI) were 53.8 % of cases while open globe injuries (OGI) were 46.2 % of cases **(Table 9a) (Figure 1).**

Cases of rupture globe represented 32.8 % of all studied cases. Rupture globe with other injuries represented 13.4 % of cases, hyphema with other injuries represented 13.9 % of cases. While ocular foreign body and corneal abrasion were the same percent (11.1 %) **(Table 9b).**

As regard to investigations Routine investigations [visual acuity (VA), slit lamp and ophthalmoscope] for minor cases that needed only medical treatment, Visual acuity [VA , slit lamp, ophthalmoscope and preoperative investigations] for cases that needed intervention, B scan was done to all cases of rupture globe and hyphema and some other cases to visualize intraocular structures, CT orbit was done when suspected intraocular foreign body or injury with sharp object caused rupture globe or fracture, and biometry was done to some cases after initial recovery from first repair to determine if the case needed glasses.

As regard to treatment:

Conservative treatment was given to cases of hyphema, subconjunctival hemorrhage and ecchymosis (hemostatic, antibiotic, anti-inflammatory, antiedema drugs), cases of endophthalmitis or corneal abscess were given (local, systemic antibiotics and analgesics), cases of burn were given (analgesic, burn cream, IV fluids and antibiotics), cases of lid edema were given (antiedema drugs) and corneal abrasion cases were given (antibiotic, anti-inflammatory and lubricant).while surgical treatment was performed for cases of rupture globe in the form of repair and wound suturing, in cases of lid wound the treatment was in the form of suturing and recommended removal of sutures after 10–14 days while in cases of foreign body; FB was removed and associated injuries were repaired

Expected period of recovery was more than 20 days in 52.8 % of cases while in the other 47.2% was less than 20 days.

As regard to the possibility to develop permanent infirmity about 62 % of cases (global ruptures, foreign bodies, and hyphema) may develop permanent infirmity if not properly treated.

As regard to duration of hospital stay in which about 26.7% of cases received treatment without admission , 69.4 % of cases stayed for short period (1-5 days), 4.2 % of cases stayed for medium period (6 – 10 days), 0.3 % of cases stayed for long period (more than 10 days) **(Table 10).**

As regard to visual acuity after an injury and first repair, the visual acuity was examined **(Table 11)** and divided into four groups **(Table 12).** 52.5 % of cases have good visual acuity while 14.6% of cases have poor visual acuity, 1/60 or hand movement or light perception.

There was very highly statistical significant difference (P < 0.001) between visual acuity after healing and the type of eye injury, as cases with rupture globe, or rupture globe with other wounds were associated with poor vision; compared to cases of lid wounds, ecchymosis, corneal abrasions and foreign body were associated with good vision after healing **(Table 13) (Figure 2).**

There was very highly statistical significant difference (P < 0.001) between visual acuity after healing and type of instrument; as cases with blunt trauma were good prognosis compared to sharp trauma, while penetrating trauma was the worst and associated with moderate and poor vision **(Table 14).**

There was very highly statistical significant difference (P <0.001) between visual acuity after healing and delay time per hours; as majority of patients who came early had good vision, compared to who came late than 1 day had poor vision or can't be assessed **(Table 15)(Figure 3).**

As regard to the outcome of the studied cases in which about 32.3 % of cases showed Stable anatomical and functional eye after healing (VA 6/6), 31.4 % of cases healed with complications (VA from 6/9 to 6/60) , 17.8% of cases with unilateral blindness (VA 1/60, HM , PL or no PL), 18.4 % of cases could not be assessed [(escaped (1.7 %), lost connection with the case (6 %), young age or non-compliance of patients (10.6 %)], 0.2 % of cases died due to other causes **(Table 16).**

Table (1): Distribution of sociodemographic data among the studied cases.

Parameter		Frequency	Percent
Age	**<1 year**	7	1.7 %
	1-6 years	100	24.7 %
	6-18 years	171	42.2 %
	18 to 60 years	117	28.9 %
	> 60 years	10	2.5 %
Sex	**Male**	297	73.3%
	Female	108	26.7%
Residence	**Urban**	201	49.6 %
	Rural	204	50.4 %
Governorate	**Sohag**	348	85.9 %
	Qena	47	11.6 %
	Luxor	3	0.8 %
	Assuit	2	0.5 %
	Others	5	1.2 %
Occupation	**Student**	198	48.9%
	Not working	123	30.4%
	Worker	84	20.7%
	Total	405	100%

Number of studied cases=405

Table (2): Distribution of circumstances of ocular injury.

Circumstances	Frequency	Percent
During work	74	18.3%
Quarrels	21	5.2 %
Traffic accidents	19	4.7%
Others	291	71.9%
Total	405	100%

Number of studied cases=405

Table (3): Distribution of injury scene among the studied cases.

Scene of crime	Frequency	Percent
Street or playground	246	60.7 %
Home	91	22.5 %
Workplace	68	16.8%
Total	405	100%

Number of studied cases=405

Table (4): Manner of ocular injury among the studied cases

Manner of ocular injury	Frequency	Percent
Accidental	384	94.8 %
Homicidal	21	5.2 %
Total	405	100%

Number of studied cases=405

Table (5): Offender in case of homicidal manner among the studied cases

Offender	Frequency	Percent
Neighbors	8	38.1%
Strangers	6	28.6 %
Friends	5	23.8%
Family members	2	9.5%
Total	21	100%

Number of studied cases=405

Table (6): Causative instrument of ocular trauma among the studied cases

Causative instrument		Frequency	Total	Percent
Penetrating objects	**stick or tree branch and wood piece**	130 cases	244	60.2 %
	nails & screwdriver	19 cases		
	road traffic accidents	19 cases		
	kitchen tools and scissors	27 cases		
	Dynamite, pinball, welding spark and firearm	28 cases		
	Glasses, pen, crown and pin	21 cases		
Blunt objects	**stones and bricks**	30 cases	110	27.2 %
	falling from height, stairs, on ground or hitting blunt object	43 cases		
	animal kick or dog bite	11 cases		
	punch assault	9 cases		
	hose, tube, wire, slab, cobble, faucet and cement	13 cases		
	clothes or shoes	4 cases		
Sharp objects	**metal object and knife**	39 cases	45	11.1 %
	broken glass	6 cases		
Unknown		6 cases	6	1.5 %
Total		405 cases	405	100%

Number of studied cases=405

Table (7): Distribution of site of injury among the studied cases.

Site of injury	Frequency	Percent
Right eye	190	46.9 %
Left eye	196	48.4 %
Both eyes	19	4.7%
Total	405	100 %

Number of studied cases=405

Table (8): Delay time between ocular injury and hospital arrival among the studied cases.

Delay time between ocular injury and hospital arrival	Frequency	Percent
Less than 6 hours	302	74.8 %
From 6 hours to less than 24 hours	15	3.7 %
From 1 day to less than 7 days	80	19.8 %
Week or more	7	1.7 %
Total	405	100 %

Number of studied cases=405

Table (9a): The distribution of type of injury (OGI or CGI) among the studied cases.

	Frequency	Percent
Closed globe injuries	218	53.8 %
Open globe injuries	187	46.2 %

Number of studied cases=405; OGI: Open Globe Injuries; CGI: Closed Globe Injuries

Table (9b): Distribution of type of ocular injury among the studied cases.

Type of ocular injury	Frequency	Percent
Rupture globe	133	32.8 %
Corneal abrasion	45	11.1 %
Foreign body	45	11.1 %
Rupture globe, hyphema	42	10.4 %
Lid wound	41	10.1 %
Hyphema	34	8.4 %
Ecchymosis	21	5.2 %
Hyphema, corneal abrasion	6	1.5 %
Rupture globe, foreign body	6	1.5 %
Ecchymosis, subconjunctival hemorrhage	5	1.2 %
Conjunctival wound	4	1 %
Rupture globe, lid wound	4	1 %
Hyphema , lid wound	3	0.7 %
Hyphema, cataract	2	0.5 %
Traumatic cataract	2	0.5 %
Burn	2	0.5 %
Hyphema, ecchymosis	2	0.5 %
Hyphema, glaucoma	1	0.3 %
Lid wound, foreign body	1	0.3 %
Subconjunctival hemorrhage	1	0.3 %
Rupture globe, glaucoma	1	0.3 %
Traumatic vitreous hemorrhage	1	0.3 %
Ant dislocated intraocular lens	1	0.3 %
Rupture globe, hyphema , lid wound	1	0.3 %
Intraorbital shots	1	0.3 %
Total	405	100%

Number of studied cases=405

Table (10): Duration of hospital stay among the studied cases.

Duration of hospital stay	Frequency	Percent
Received treatment without admission	108	26.7 %
Short stay (1-5 days)	279	69.4 %
Medium stay (6-10 days)	17	4.2 %
Long stay (more than 10 days)	1	0.3 %
Total	405	100 %

Number of studied cases=405

Table (11) Visual acuity after healing among the studied cases

Visual Acuity	Affected eye			Frequency	Percent
	Single eye	Both eyes			
6/6	119	12		131	32.3 %
6/9	35			35	8.6 %
6/12	21			21	5.2 %
6/18	13			13	3.2 %
6/24	4			4	1 %
6/36	6			6	1.5 %
6/60	46			46	11.4 %
1/60	18			18	4.4 %
Hand movement	16			16	4 %
Perception of light	25			25	6.2 %
No perception of light	13			13	3.2 %
Different in both eyes	-	**right**	**left**	2	0.5 %
		6/18	6/36		
		6/36	6/18		
Could not be assessed	70	5		75	18.5 %
Total	386	19		405	100%

Number of studied cases=405

Table (12): Levels of visual acuity after healing among the studied cases.

Levels of visual acuity after healing	Frequency	Percent
Good vision	212	52.5 %
Moderate vision	46	11.4 %
Poor vision	59	14.6 %
No perception of light	13	3.2 %
Could not be assessed	75	18.3%
Total	405	100%

Number of studied cases=405

Table (13): Chi-square test of visual acuity after healing according to the type of ocular injury among the studied cases.

Visual acuity		Type of injury									Total
		RG	hyphema	FB	Lid wound	ecchymosis	RG with other wounds	yphema with othe wounds	Others	Corneal abrasion	
Good vision	N	21	29	38	40	17	6	10	10	41	212
	%	15.8%	85.3%	84.4%	97.6%	100.0%	10.9%	76.9%	47.6%	91.1%	52.5%
Moderate vision	N	32	0	1	0	0	9	0	0	4	46
	%	24.1%	0.0%	2.2%	0.0%	0.0%	16.4%	0.0%	0.0%	8.9%	11.4%
Poor vision	N	29	0	1	0	0	23	1	5	0	59
	%	21.8%	0.0%	2.2%	0.0%	0.0%	41.8%	7.7%	23.8%	0.0%	14.6%
No perception of light	N	10	0	0	0	0	3	0	0	0	13
	%	7.5%	0.0%	0.0%	0.0%	0.0%	5.5%	0.0%	0.0%	0.0%	3.2%
Cannot be assessed	N	41	5	5	1	0	14	2	6	0	75
	%	30.8%	14.7%	11.1%	2.4%	0.0%	25.5%	15.4%	28.6%	0.0%	18.3%
Total	**N**	133	34	45	41	17	55	13	21	45	405
	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
χ^2		**250.5**									

Number of studied cases=405;* Significant P value < 0.05; ** Highly significant P value < 0.01; *** Very highly significant P value < 0.001; NS: Non significant P value > 0.05; RG: rupture globe; FB: foreign body

Table (14): Chi-square test of visual acuity after healing according to causative instrument among the studied cases.

Visual acuity		causative instrument				Total
		Sharp	Blunt	Penetrating	Unknown	
Good vision	Count	20	75	115	2	212
	%	44.4%	68.2%	47.1%	33.3%	52.3%
Moderate vision	Count	4	3	39	0	46
	%	8.9%	2.7%	16.0%	0.0%	11.4%
Poor vision	Count	12	10	36	1	59
	%	26.7%	9.1%	14.8%	16.7%	14.6%
No perception of light	Count	1	4	8	0	13
	%	2.2%	3.6%	3.3%	0.0%	3.2%
Cannot be assessed	Count	8	18	46	3	75
	%	17.8%	16.4%	18.9%	50.0%	18.5%
Total	Count	45	110	244	6	405
	%	100.0%	100.0 %	100.0%	100.0%	100%
χ^2		30.9				
P value		**P=0.002				

Number of studied cases=405; * Significant P value < 0.05; ** Highly significant P value < 0.01, *** Very highly significant P value < 0.001; NS: Non significant P value >0.05

Table (15): Chi-square test of visual acuity after healing according to delay time per hour among the studied cases.

Visual acuity after healing		Delay time between injury & hospital arrival				Total
		Less than 6 hours	6- 24 hours	1- 7 days	more than one week	
Good vision	N	184	6	21	1	212
	%	60.9%	40.0%	26.3%	14.3%	52.5%
Moderate vision	N	36	4	6	0	46
	%	11.9%	26.7%	7.5%	0.0%	11.4%
Poor vision	N	34	3	22	0	59
	%	11.3%	20.0%	27.5%	0.0%	14.6%
No perception of light	N	5	1	6	1	13
	%	1.7%	6.7%	7.5%	14.3%	3.2%
Cannot be assessed	N	43	1	25	5	75
	%	14.2%	6.7%	31.3%	71.4%	18.3%
Total	**N**	302	15	80	7	405
	%	100.0%	100.0%	100.0%	100.0%	100.0%
χ^2		66.7				
P value		***P < 0.001				

Number of studied cases=405
* Significant P value < 0.05
** Highly significant P value < 0.01
*** Very highly significant P value < 0.001
NS: Non significant P value >0.05

Table (16): The outcome among the studied cases.

Outcome		Frequency		Percent	
Stable anatomical and functional eye after healing		131		32.3 %	
Healed with complications		127		31.4 %	
Unilateral blindness		72		17.8 %	
Could not be assessed	Escaped	7	74	1.7%	18.4%
	lost connection with the case	24		6%	
	young age or non-compliance of patients	43		10.6%	
Death due to other causes		1		0.2 %	
Total		405		100 %	

Number of studied cases=405

A) **(B)**

C) **(D)**

(Figure 1)

Figure (1): Examples of eye injuries from the studied cases: (A) 42 years old female with right global rupture with gapped cataract wound. (B): 6 years old female with traumatic hyphema in the left eye. (C): 36 years old male with right intraocular foreign body with global rupture. Figure (D): 19 years old female with left upper lid wound caused by motor car accident.

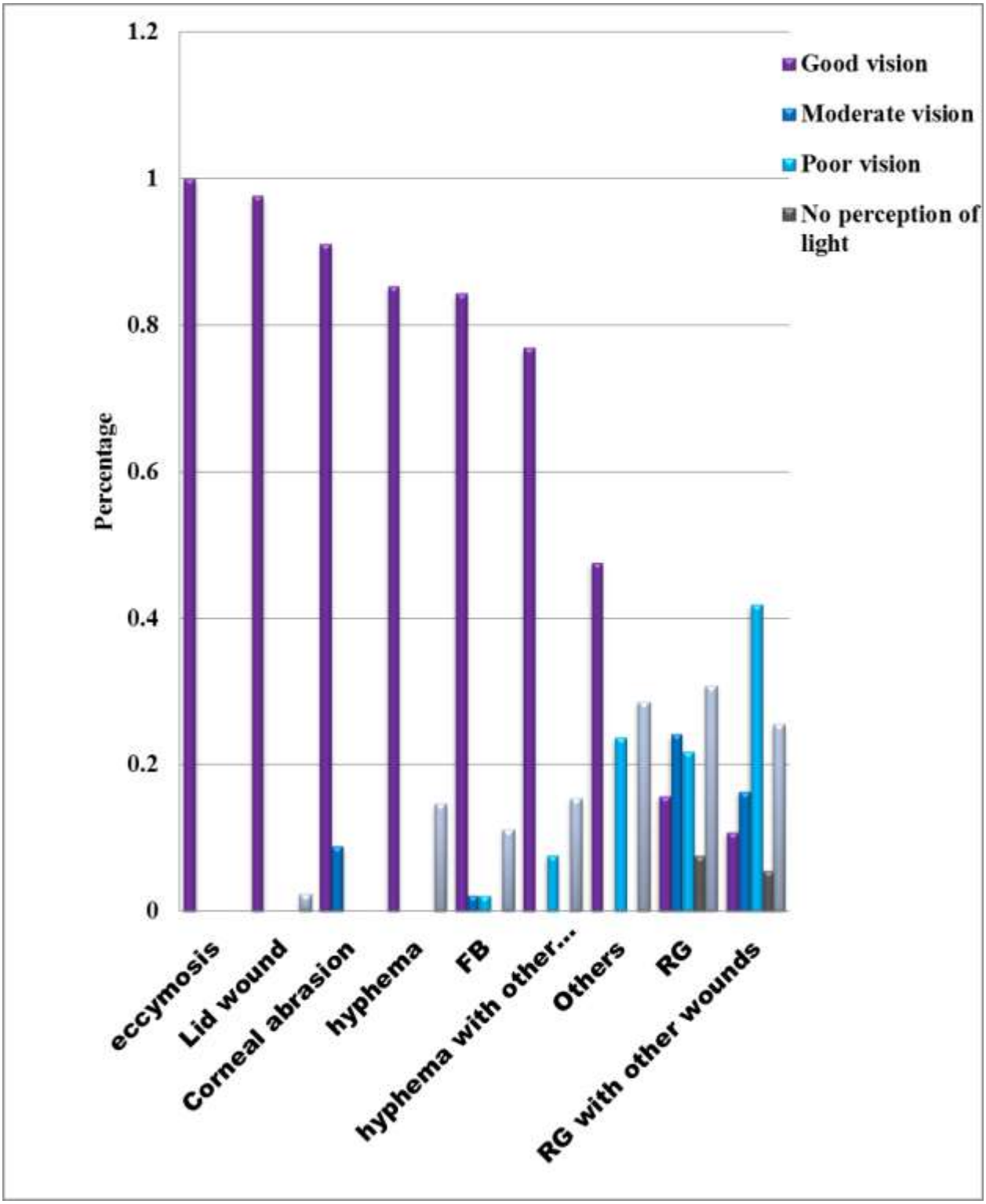

Figure (2): Bar chart showing visual acuity after healing according to type of injury among the studied cases (N = 405 cases).

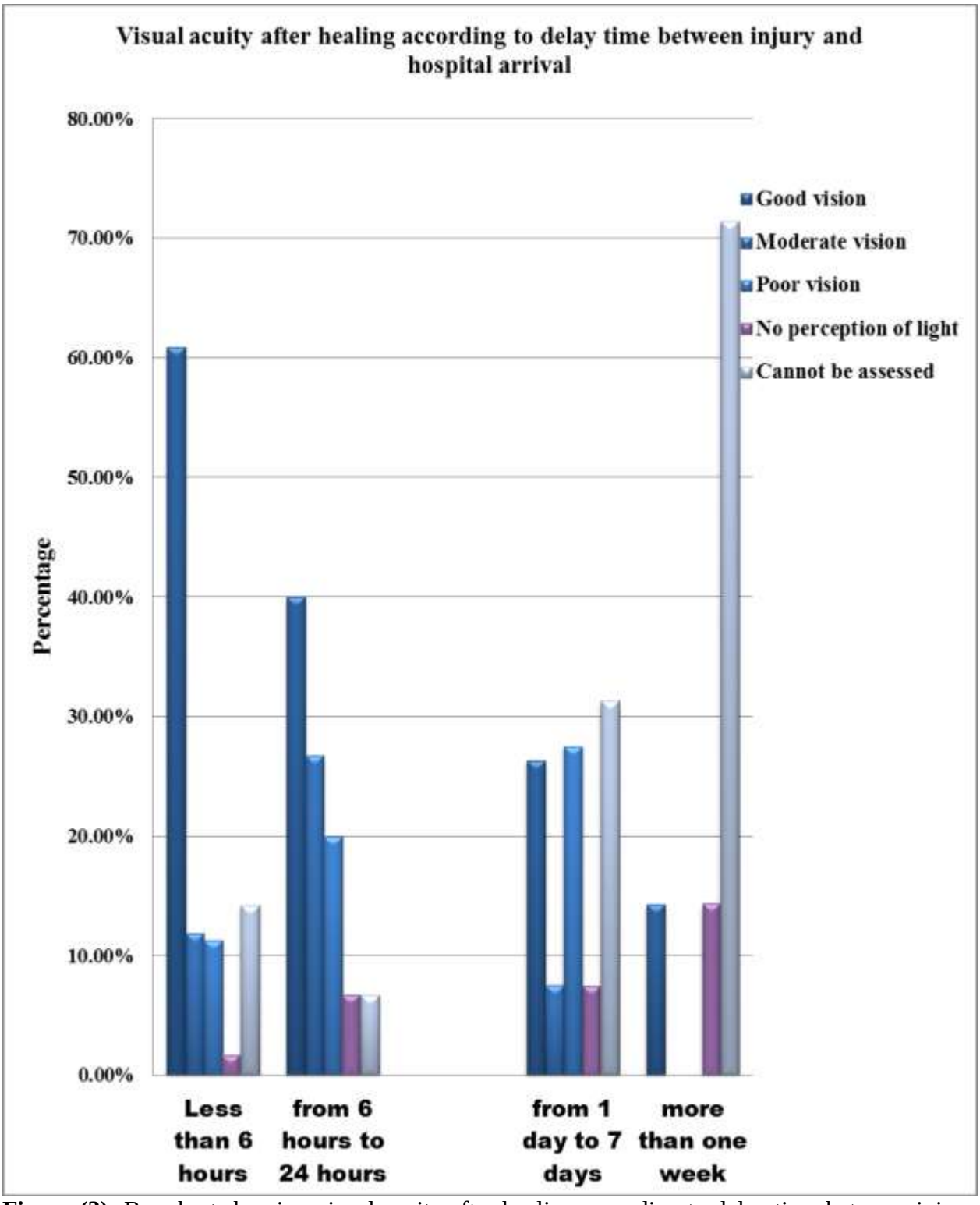

Figure (3): Bar chart showing visual acuity after healing according to delay time between injury and hospital arrival among the studied cases (N = 405 cases).

IV. DISCUSSION

Ocular injuries are more common in underdeveloped nations and a preventable cause of blindness and monocular vision impairment (Tesyafe and Bejiga, 2008). It is a significant contributor to morbidities and illnesses, especially in the pediatric population (McGwin et al., 2005 and Mayeka et al., 2017).

The effects of sight loss brought on by occupational ocular injuries have a direct and indirect impact on employees' and their families' futures, on social interaction, and on the growth and prosperity of the nations (Alem et al., 2018).

The present study is a prospective cross sectional study which included patients presented by ocular injuries to the Sohag Ophthalmology Department from 1st of January 2022 to 30th of June 2022. Within this study, Patient's collected data included age, sex, residence, governorate, occupation, circumstances, crime scene, manner of ocular injury, offender in case of homicide, duration of presentation, weapon used, site of trauma and type of injuries. The reason for injuries ended up being differentiated into blunt, sharp or penetrating. The prepared sheet of the hurt eye was fulfilled by the patient data, and information was recorded based on the standardized classification of ocular trauma. Patients were treated and followed up after treatment; their visual acuity was measured using Landolt C chart, some needed to measure intraocular pressure (IOP) and some needed further intervention.

The current epidemiological study aimed to assess all cases of ocular trauma presented to Sohag University Hospitals. Through this study, data had been collected over a period of 6 months and was conducted on 405 subjects aged from 6 months to 65 years. It depends on similar results as the study performed by Abdellah et al. (2022) who assumed that cases admitted were 72 to get percentages of blunt trauma about 50%, confidence level 95% and within an error probability of 0.05 The minimum needed cases for the present study is 70 cases.

In the present study children below 18 years of age were more susceptible to ocular injuries while playing (68.6%), which could be attributed to the lack of parental supervision during play and other activities, whether indoors or outdoors, and the age of teenagers who like playing and engaging in other activities.

The present results were in agreement with the study performed by Syal et al. (2018) who observed that most injuries occurred during playing in the streets and roads (66%), and the study of Soliman and Macky (2008) who studied the pattern of ocular trauma in Egypt among cases admitted to Kasr El Aini Hospital found that 49.7% of all cases were younger than18 years.

This was in disagreement with the study performed by Shrestha et al. (2021) who found that one-fourth of the patients were under the age of 10 and in their second or third decade of life, which may be related to the higher risk that this age group faces in their line of work or as a result of their frequent social interactions.

Children suffer ocular injury at a higher rate than adults; this may be related to the fact of their activeness, curiosity, inexperience, need for self-defense and consciousness. According to statistical evidence, pediatric ocular trauma is the primary cause of childhood blindness and

acquired visual impairment (Xue et al., 2020).

Consistent with Abdellah et al. (2022) the current study observed male dominance (73.3%) of ocular trauma with a male: female ratio of 2.75: 1, this male dominance is assumed to be associated to workplace exposure, involvement in risky hobbies and sports, drinking and risk-taking behavior.

This was in accordance with the study performed by Ho et al. (2021) in which male preponderance was (84.6%), and also the study of Quartantri (2022) who confirmed that boys experience ocular injuries more frequently than girls.

It is more common for men than women to work in dangerous jobs, and they also tend to work outside or in more aggressive ways (Tök et al., 2011).

In the current study, 50.4% of the patients who suffered trauma were from rural areas, which could be related to illiteracy, ignorance, exposure to work without protective equipment, and inadequate parental supervision, which may have been another factor contributing to ocular trauma , this was supported by (Bayoumi et al., 2020).

The current study was consistent with the study of Syal et al. (2018) where a significant number of the trauma patients (74%) came from rural locations, and the study of Abdellah et al. (2022) in which the most cases were from rural areas (87.5%) and the study of Salama and Badr El Dine (2014) that discovered that 47.6% of cases were from urban areas and 52.4% from rural areas.

In contrast, the study performed by Elsayed et al. (2019) in which patients living in rural areas made up 38.5% of the patients, perhaps because most rural cases went to a nearby rural hospital, while patients living in urban areas made up the bulk of cases (61.5%).

Regarding occupation, students represented 48.9 % of cases, not working cases represented about 30.4 % of cases, and workers represented 20.7 % of cases it has been determined that students and children bear the most of the burden of ocular injury. Workers with machinery and rough tools and youngsters with various sharp objects associated to school or the playground are the two patient types most exposed to sharp objects. This was supported by Soliman and Macky (2008).

In the present study, 18.3% of cases were injured during work and the majority of cases were injured accidently by other circumstances as most of cases were less than 18 years who were more susceptible to ocular injuries while playing or during other activities. Only 4.7% injured due to traffic accidents.

In contrast to the study of Hafez et al. (2020) who studied permanent infirmity and found that the majority (47.2 %) of cases had permanent infirmity due to road traffic accidents; 28.6% due to quarrel.

In the current study, The majority of cases (60.7%) occurred in the street or playground, 22.5 % of cases occurred at home and 16.8% of cases occurred in work place. This was in agreement with the study of Hafez et al. (2020) who showed that the majority (80%) of cases of permanent infirmity occurred in the street

The majority of the cases (94.8%) were accidental, while only 5.2% were homicidal. Previous research indicating that most eye injuries are unintentional supports this (Podbielski et al., 2009). The present result was supported by the study performed by Shrestha et al. (2021) and the study of Abdellah et al. (2022).

In contrast to the study of Salama and Badr El Dine (2014) in which 56.1% of eye injuries were caused by assaults, while 43.9% of patients suffered unintentional injuries.

In case of homicidal manner in the present study; neighbors were the offender in 8 cases, strangers were the offender in 6 cases, friends were the offender in 5 cases and family members were the offender in 2 cases. (Hafez et al. 2020) found that neighbors are the offender in 27cases, A family member is the offender in 11cases, while a stranger is the offender in nine cases and a friend is the offender in eight cases.

In the current study, penetrating objects were the leading agents that cause eye injury among all injuries (60.2 % of cases) specially sticks and tree branches, maybe due to the fact that the study was conducted in Upper Egypt in which many peoxple live in rural areas and use these objects frequently and kids play with sticks and many adults work in the field manual work.

The present study was in line with the study performed by Elsayed et al. (2019) and also supported by the study of Puodžiuvienė et al. (2018) in which the most frequently reported blunt object was wooden stick (24.8%), followed by sports equipment, stone and fruits or vegetables. The three most frequent things that cause eye injuries in children are wood, stone and sharp objects.

The present study was in agreement with the study performed by Shrestha et al. (2021) who found that vegetative material like sticks and branches was the most frequent cause of damage, followed by metal. Soliman and Macky (2008) indicated that thrown stones and sticks were the primary causes of injuries. Sports-related injuries and fist fights were less frequent. In addition, compared to prior research, there were more injuries caused by sharp objects in their study. Knife wounds were the leading cause of sharp trauma, with scissors, glass and pen wounds occurring less frequently.

In contrast , a study performed by Syal et al. (2018) metal fragments/nails were the main agents that cause eye injury among all injuries because the local work tasks included grinding, drilling, welding, carpentry, hammering metal cutting and nailing which use powerful instruments that generate metal fragments/nails at high velocities and frequently have disastrous consequences on the eye.

Notably, With the exception of domestic falls, where most patients were female, other injury causes, when contrasted by sex, showed a male prevalence. Domestic falls were more common in older people when the mechanism of injury was broken down by age groups; this may be because older people are more likely to have comorbid conditions such connective tissue disease, osteoporosis, and degenerative neurological illnesses. Younger patients in their early third decade of life were more likely to sustain injuries from motor vehicle accidents, explosions and shotguns (Beshay et al., 2017 and Okamoto et al., 2019).

Similar results were obtained by Wasfy et al. (2009) who discovered that blunt instruments were responsible for 63.6 % of eye damage and sharp instruments for only 17.8 %. In addition Salama and Badr El Dine (2014) who found that sharp devices only accounted for 17.8 % of eye injury and blunt instruments for 63.6 %. , Addisu (2011) noticed that blunt instruments were the primary source of eye damage, and Soliman and Macky (2008) discovered that

blunt object trauma is still the leading cause of eye damage.

In the present study the incidence of bilateral eye injury was 4.7 % only, 46.9% in right eye injury while left eye injury was 48.4 %. , It is supported by the study of Salama and Badr El Dine (2014) in which bilateral affection only accounts for 12.2% of cases, while single eye affection accounting for 87.8 % of all cases. Soliman and Macky (2008) showed that only 4% of cases had bilateral eye injuries. Also, Addisu (2011) found that over the course of a year, just 1.5% of patients at Grarbet Hospital in Butajira, Central Ethiopia, experienced bilateral ocular involvement.

In the present study, 78.5% of the patients reported within 24 hours of trauma, fortunately 74.8 % reported within 6 hours. The present study was supported by Syal et al. (2018). This is significant in terms of prognosis since early diagnosis and treatment improves prognosis, whereas delayed treatment after even small injuries might end in blindness. The present study was against the result of Soliman and Macky (2008) in which there was a delay in presentation was visible in about 18 % of individuals. Elsayed et al. (2019) discovered that 24% of patients arrived late (by more than 24 hours).

In the present study the cases were with open wound and delayed presentation (after 48 hours). These delayed patients some were ignorant and some claimed that they were not sufficiently aware about the severity of trauma as they did not expect the damage to be severe enough to need hospitalization and intervention. However, a few of them did indeed seek medical advice in a nearby medical center as Sohag University Hospital was far away from them, but unfortunately they were not given the proper medical and/or surgical care.

In the present study closed globe injuries (CGI) were 53.8 % of cases while open globe injuries (OGI) were 46.2 % of cases.

The current results were supported by Syal et al. (2018) who found that closed globe injuries more common about 60.5%, and also Elsayed et al. (2019) discovered that, for lamellar lacerations and contusions, respectively, 33.75 and 49.25 percent of cases involved closed-globe injuries. Most admitted patients' injuries (17 % of all patients) were open-globe injuries, whereas 12% of all patients had ruptured globes.

On the contrary, Al Wadeai et al. (2016) indicated that open globe injuries were the most common reason for hospitalization. In addition, Ahmed and Zaki (2013) reported that more open globe injuries than closed globe injuries were seen in patients during the year of the Egyptian Revolution.

The most common closed globe injuries were caused by foreign body and corneal abrasion. Penetrating injuries were the most common open globe injuries, this was supported by (Syal et al., 2018), (Elsayed et al., 2019), (Puodžiuvienė et al., 2018) and (Salama and Badr El Dine, 2014).

In the present study ocular foreign body represented 11.1 % of cases but in the study of Elsayed et al. (2019) the most frequent reasons for visiting the ocular emergency room were superficial corneal foreign bodies, which were treated right away. They were the cause of injuries in 44.5% of patients, and ocular foreign bodies were twice as common in urban regions as they were in rural ones.

In the present study, patients were either treated medically or surgically. Corneoscleral perforation repair and eyelid reconstruction were the most common

procedures performed, this was supported by (Syal et al., 2018).

Blindness could result from open globe injury, which endangers vision (Schmidt et al., 2008). Kutlutürk Karagöz et al. (2018) reported that males are more likely than females to suffer an open globe injury.

After an injury and first repair, the visual status was evaluated and categorized into four groups:
Good visual acuity (52.5 %), moderate visual acuity (11.4 %), poor visual acuity (14.6%), blind eye (3.2 %)
There was 18.3 % Cases could not be assessed due to non-compliance of patients or were infants.

In the group of cases who had closed globe injury had good ultimate visual acuity 52.5%. While cases with open globe injury had reduced visual acuity up to 1/60 or less in 17.8% of cases. But cases who received their specific treatment early with no complications had better visual acuity.

It was observed that cases who presented sooner (in less than six hours) had better final visual acuity (VA) than cases who presented later (after more than a day). Poor visual acuity was more common in complicated cases of global rupture caused by retinal detachment, endophthalmitis, vitreous haemorrhage and cases with numerous lesions.

The present results were in agreement with the study performed by Puodžiuvienė et al. (2018) whereas 65.4% of the injured children were able to regain good vision (≥ 0.5).

Salama and Badr El Dine (2014) reported that 29.3% of all patients were presented with visual acuity; counting fingers up to 20/200 and 22% of all patients had light perception. Mayeka et al. (2017) found that 44% of children admitted to the eye department at Mulago Hospital in Uganda with eye injuries had vision problems in the affected eye. Abdellah et al. (2022) found that 48.64% of individuals with closed globe trauma had good final visual acuity. 13.51% of patients with closed globe injuries and 77.14% of patients with open globe injuries had poor visual acuity in their eyes.

According to research, posterior wounds cause more cases of impaired visual acuity than anterior wounds (Xue et al., 2020). When the retina and the optic nerve damaged there was impairment of visual acuity as the location of the wound is a statistically significant prognostic factor.

According to the outcome in the present work, 32.3 % of cases completely recovered (stable anatomical and functional eye after healing with VA 6/6) as most of them were superficial and not dangerous such as lid wound, ecchymosis, some cases of hyphema, superficial foreign body and non-complicated scleral wounds. 31.4 % of cases healed but decreased visual acuity after healing due to complications such as infection or wound affected cornea healed by fibrosis, and 17.8% of cases developed unilateral blindness (VA less than 3/60, HM, PL or no PL) due to delayed reporting or neglicance or severe injury mostly corneal and corneoscleral wounds complicated with retinal detachment and other severe complications or deep neglected foreign body that caused complications such as pan-ophthamitis. Cases that received treatment early and followed up regularly had better outcome than delayed cases and cases that neglected regular follow up.

Salama and Badr El Dine (2014) reported that 46.3% of patients with ocular injuries experienced permanent infirmity, with cases of moderate and severe trauma being referred to the ophthalmology

department whereas cases of minor trauma were not. Puodžiuvienė et al. (2018) discovered that 32.8% of OGI (open globe injuries) resulted severe visual impairment or blindness (VA 0.1), but the majority of CGI (closed globe injuries) (81.7%) caused no long-term visual impairment in the injured eye.

There was very highly statistical significant difference (P < 0.001) between visual acuity after healing and the type of eye injury, as cases with rupture globe, or rupture globe with other wounds were associated with poor vision; compared to cases of lid wounds, ecchymosis, corneal abrasions and foreign body were associated with good vision after healing.

Similar results were obtained from Rasool et al. (2020) who found that Better visual outcome was seen in their patients, due to lid involvement in 39.4% where globe was spared. Most patients in our study generally presented with mild injuries including subconjunctival haemorrhages, conjunctival and corneal foreign bodies and corneal abrasions. Patients with vitreous haemorrhage and choroidal tear had guarded prognosis

There was very highly statistical significant difference (P < 0.001) between visual acuity after healing and type of instrument; as cases with blunt trauma were good prognosis compared to sharp trauma, while penetrating trauma was the worst and associated with moderate and poor vision.

There was very highly statistical significant difference (P <0.001) between visual acuity after healing and delay time per hours; as majority of patients who came early had good vision, compared to who came late than 1 day had poor vision or can't be assessed.

A study conducted in India in 2017 revealed that BCVA (Best corrected visual acuity), size of corneal tear, type of injury, time period between injury and treatment are significant factors determining the outcome of trauma. (Rasool et al. 2020)

On comparing the records of presented visual acuity with those of discharge, there was no obvious decline, despite the difficulty in precisely recording the visual acuity at presentation. The opposite was also true in other instances, where things improved. Endophthalmitis, cataract formation or retinal detachment are common consequences of those who experience decreased eyesight. In this study, the primary visual outcome following hospital release is impaired vision. But the end result cannot be relied on. Following up, considerable improvement in vision was seen in many patients afterward. However, the majority of patients' follow-up was not enough.

The present study was limited by the noncompliance of some patients (some escaped and did not follow up) and by the fact that some required additional interventions in hope to improve vision so they travelled to operate. and also the difficult management of pediatric patients: questionable circumstances surrounding eye injury, difficulties in collecting information from ocular examination (VA), variable follow up times and periods, different surgeons etc.

The current study revealed that causative instrument, type of injury and delay time between injury and management were significant factors determining the final VA and outcome of trauma.

V. Conclusion

The present study concluded that:

- The most common age group affected was less than 18 years.
- The most common causative instruments were penetrating objects.
- The most common mode of blunt trauma causing CGI was falling then stones and bricks
- There was no cases with medical negligence
- Early seeking medical advice, early management leading to better outcome
- Cases that developed permanent infirmity were common with cases of rupture globe who delayed seeking medical advice or with severe complications or deep neglected foreign body that caused complications such as pan-ophthamitis.

VI. Recommendations

It is recommended to

1. Educate individuals in general to use safety eyewear; this might significantly reduce worker injuries.
2. Children need extra care as they are the most common age group affected in the study and dangerous items such as dynamite and pinball should be prohibited.
3. Urge people to seek immediate medical care if an eye injury has occurred, as distance was not a reason for the patients delay in seeking care.
4. Minute examination with detailed professional documentation is very important in such cases.
5. Due to poor compliance with follow-up examinations and secondary rehabilitation, trauma patients should receive comprehensive primary management.
6. Practitioners also must be specialized in these particular problems. Only then they can become experienced and well trained in trauma evaluation, sequels and impairment.
7. Employees need to be regularly reminded that their field of work carries a risk of eye damage.
8. All weapons and instruments of violence should be prohibited, and they should only be allowed under particular conditions and with proper authorization.

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دراسة مستقبلية عن النواحي الطبية الشرعية لاصابات العين في صعيد مصر والنتائج المترتبة عليها

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مقدمة: تعتبر إصابات العين- والتي يمكن تجنبها- أكثر الأسباب شيوعًا للعمى وضعف البصر في الدول النامية. إن آثار فقدان البصر الناجم عن إصابات العين المهنية لها تأثير مباشر وغير مباشر على مستقبل الموظفين وأسرهم، وعلى التفاعل الاجتماعي، وعلى نمو وازدهار الأمم.**الهدف من الدراسة:** هدفت الدراسة الحالية الي تقييم حالات إصابة العين والنتائج المترتبة عليها ولتحديد ما إذا كان الوصول إلي المستشفي والتدخل المبكر للتعامل مع الحالات والعلاج المناسب سيؤثر علي نتيجة الحالات وحدوث عاهة مستديمة من عدمه. **خطة البحث:**أجريت الدراسة الحالية كدراسة مستقبلية في الفترة من 1 يناير 2022 الي 30 يونيو 2022على إجمالي 405 فرد من الحالات المترددة علي قسم طب وجراحة العيون في مستشفيات سوهاج الجامعية. تم قياس حدة البصر لجميع الحالات المصابة بعد الشفاء التام باستخدام مخطط لاندولت.**النتائج:** توصلت الدراسة الحالية إلي أن معظم حالات الاصابة كان عمرها تحت سن 18 سنة (طلاب وأطفال) والأغلبية ذكور. وكانت الأدوات الخشبية والأغصان هي الأسباب الرئيسية لإصابة العين تليها أدوات المطبخ والأجسام المعدنية. وكان الأكثر شيوعًا من إصابات مقلة العين المغلقة نتيجة وجود أجسام غريبة ، وتآكل القرنية. بينما كانت الإصابات التي تخترق العين أكثر إصابات تمزق مقلة العين شيوعًا.**الاستنتاج:**وجد أن الحالات التي قدمت مبكرا في أقل من 6 ساعات كانت حدة الابصار عندهم أفضل مقارنة مع أولئك الذين قدموا بعد أكثر من يوم واحد . والحالات التي حدث لها مضاعفات، والحالات ذات الاصابات المتعددة كان بصرها أضعف من الحالات الأخرى . والحالات التي تم علاجها مبكرًا ومتابعتها بشكل منتظم كان لها نتائج أفضل من الحالات المتأخرة والحالات التي أهملت المتابعة المنتظمة.