

# Traumatic Blindness—A Clinical Study

Ravin Kumar Mishra

Nagar School of Optometry, Gujrat University, Ahmedabad, India

Email: ravine.me@gmail.com

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## Abstract

**Background:** As a cause of blindness, ocular injury constitutes 1.5% of all causes of blindness. In the developed world, trauma is also the leading cause of unilateral blindness and is preceded only by the cataract as a cause for vision impairment. Males are much more likely than females to sustain ocular trauma. The ocular effects of trauma can be far-reaching, so timely intervention is of prime importance to improve the visual outcome. **General Objective:** To evaluate the visual outcome after ocular injury. **Methods:** This study was conducted at Nagri Eye Hospital, Ahmadabad. In total, 68 eyes of 68 patients with eye injury were included in this study. Detail history was taken from the entire patient and a detailed ocular examination was done. **Results:** The mean age of incidence of the patients was  $25.39 \pm 16.89$ . The commonest age group presented with ocular trauma was <10 yrs followed by the 2<sup>nd</sup> decade, *i.e.*, 11 - 20 yrs. A great majority of patients were male with the mean age of  $25.89 \pm 16.55$  accounting for 83.82%. The majority of the patients have visited the hospital in between the time period of 24 hrs - 1 wk (57.35%), followed by 23.52% within the time period of <24 hrs. The majority of the patients got their eyes traumatized during industrial work (27.94%) followed by domestic work (26.47%). 19.11% of patients have got the trauma during agricultural activity. The commonest type of ocular trauma was with wooden material (19) followed by metallic (13). The blunt types of trauma were most frequent accounting for 42.64% followed by combined blunt and perforating 32.35%. A comparative study of visual recovery was also done between the presenting visual acuity and the final visual outcome after 3 months by using paired t-test, which showed marked visual improvement from 1<sup>st</sup> visit to the final visit ( $p$ -value < 0.005). **Conclusions:** The majority of cases were youth males with the age group of 25 yrs. All the cases with ocular trauma were unilateral. The trauma was common in industrial workers with the majority of the cases of blunt type. There was satisfactory visual improvement in patients who followed-up well.

## Keywords

Ocular Injury, Trauma, Visual Outcome, Visual Improvement

## 1. Introduction

Ocular trauma is unfortunate, yet it is a relatively common condition treated in today's optometric practice. As primary eye care providers, we must stay up-to-date with current trauma management principles. It is important to review common as well as unusual traumatic conditions that may be seen and/or necessarily ruled out when examining a patient who has sustained trauma [1].

The ocular effects of trauma can be far-reaching and profound; therefore, it should never be underestimated. Using a thorough systematic approach (including dilation as usual) when examining for ocular trauma will serve the clinician and the patient alike [2].

It is very important to keep in mind that patients with mild ocular traumatic conditions, such as periorbital ecchymosis and subconjunctival hemorrhages, need to be examined very carefully as these events signal to us that the eye has sustained a substantial injury that may have caused more serious problems. The examiner must be vigilant when examining these patients and remember to document thoroughly. Follow-up is also critical since sequelae from trauma may be more obvious and profound at a later time [3] [4].

### 1.1. Epidemiology

There are approximately 3 million ocular and orbital injuries in the US per year. Of those injuries, approximately 20,000 to 68,000 are vision-threatening injuries and 40,000 sustain significant vision loss. In the US, trauma is the leading cause of unilateral blindness and is preceded only by the cataract as a cause for vision impairment. Males are much more likely than females to sustain ocular trauma and this is especially true for young males [3] [4].

In the Beaver Dam Eye Study, 20% of adults reported ocular trauma in their lifetime and these people were 3 times more likely to experience further ocular trauma. In this study, sharp objects caused more than half of all injuries. Surprisingly, home seems to be more dangerous in terms of traumatic eye injuries than the workplace, but about 23% of all ocular injuries are sports-related. Baseball seems to be the most dangerous sport in terms of these injuries. Interestingly, fishing is the second most dangerous sport with accounting for 25% of these ocular injuries. Although proven to be effective in saving lives, frontal airbags have caused a two-fold increase in eye injuries related to motor vehicle accidents [5] [6].

In the USA, the frequency of traumatic ocular conditions is as follows:

- Superficial injury of the eye and adnexa (41.60%);
- Foreign body on the external eye (25.40%);
- Contusion of the eye and adnexa (16.00%);
- Open ocular adnexa and eyeball wounds (10.10%);
- Orbital floor fracture (1.30%);
- Nerve injury (0.30%).

## 1.2. Pathophysiology

There are four main mechanisms that cause ocular trauma: coup, contrecoup, equatorial expansion and global repositioning. The coup (pronounced “koo”) is the initial force caused directly by the trauma [7]. The contrecoup is the shock-wave that is imparted by the coup and is transmitted throughout the ocular and orbital structures. During blunt trauma, the equator of the globe tends to expand and, therefore, distort the normal ocular architecture. Finally, the globe returns to its normal shape, but this is not always a benign event and can cause damage as well. Keep in mind that this is all occurring to tissues and structures that have varying degrees of elasticity and tensional strength. For example, the sclera is rigid due to collagen fortification and the retina is flexible, but the RPE and Bruch’s membrane are less elastic. These differences in mechanical properties play a major role in ocular trauma pathophysiology [7] [8].

## 1.3. Classification

In a broad sense, the two main categories that ocular trauma can be divided into are closed and open globe injuries. When examining a patient with trauma, it is imperative to determine which of these categories a patient belongs to as this will direct the immediate management of the patient’s condition [9].

Patients with closed globe injuries have a contusion or a lamellar laceration. Patients with open globe injuries have a rupture or a laceration, with the latter being either a penetrating or perforating injury. While seemingly fairly obvious, differentiating between a closed and open globe injury can be on occasion somewhat difficult [9] [10].

Generally, there are two main agents that can cause an ocular chemical burn; bases and acids.

## 1.4. Bases

Alkaline (basic) agents are particularly damaging due to their hydrophilic and lipophilic properties which allows them to rapidly penetrate cell membranes and the anterior chamber within minutes. Damage results from saponification of cell membranes and cell death along with disruption of the extracellular matrix [10] [11].

Limbal involvement is so important because that is where the corneal stem cells that replenish the epithelium are located.

## 1.5. Acids

Acids generally cause less damage than bases as many corneal proteins bind acid and act as a chemical buffer and coagulated tissue acts as a barrier to further penetration of acid. Damage usually results from collagen fibril shrinkage, which can cause symblepharon formation [12] [13].

If a patient presents to the office, begin irrigation immediately for at least 30 minutes. Sterile saline is preferable, but if not available, use tap water and anes-

thetize as necessary. Moderate to severe burns usually require a referral to a corneal specialist as appropriate and hospital admission may be necessary [14] [15].

## 1.6. Objectives

### General objectives

To evaluate the visual outcome after traumatic ocular injury.

### Specific objectives

- 1) To evaluate the visual outcome after traumatic ocular injury;
- 2) To evaluate the incidence of types of trauma;
- 3) To know the common agent of trauma.

## 2. Review of Literature

**1) In a study “burden of traumatic blindness: needs more attention”** (Dr. Shashi Agrawal, Dr. Ram Prakash, Dr. Rathore M.K.)

**Aims:** To provide epidemiological data in order to facilitate the provision of integrated eye care and safety strategies for the prevention of traumatic ocular blindness.

**Result:** 556 eyes of 543 patients with ocular trauma were included in this study. There were 78% males and the average age was 32 yrs. 59% patients sustained occupational ocular injury out of which 48% patient had agricultural related and 41% patient had non-occupational ocular injuries. Commonest causative object of trauma was wooden in 42% patients. 45% patient had closed globe, 26% patient had open globe and 29% had adnexal injuries. Presenting visual acuity = 1/60 was found in 85% cases of open globe injury. Visual outcome was nearly four times poor in open globe injury. Majority of patients (97%) did not wear any protective device at the time of trauma [7].

**2) The epidemiology of ocular trauma in rural Nepal** (Khatry S.K., Lewis A.E., Schein O.D.)

**Aims:** To estimate the incidence of ocular injury in rural Nepal and identify details about these injuries that predict poor visual outcome.

**Results:** 525 cases of incident ocular injury were reported, with a mean age of 28 years. The most common types of injury were lacerating and blunt, with the majority occurring at home or in the fields. 82% were examined at follow up: 11.2% of patients had visual acuity worse than 20/60 and 4.6% had vision worse than 20/400. A poor visual outcome was associated with increased age; care sought at a site other than the eye clinic, and severe injury [11] [16].

**3) Eye injuries in children: the current picture** (Caroline J. MacEwen, Paul S. Baines, Parul Desai)

**Aims:** To investigate the current causes and outcomes of paediatric ocular trauma: Mar'1999.

**Results:** The commonest mechanism of injury was blunt trauma, accounting for 65% of the total.

Injuries necessitating admission occurred most frequently at home (51%). Spor-

ting activities were the commonest cause of injury in the 5 - 14 age group. There were no injuries caused by road traffic accidents or fireworks. One (1%) child had an acuity in the “visually impaired” range (6/18 - 6/60) and one (1%) was “blind” (6/60) in the affected eye. No child was bilaterally blinded by injury and none required blind or partial sight registration [16] [17] [18].

### 3. Methods

The design of the study is a Hospital based prospective study. Duration of the study is 1 year from Oct 2010 to Sep 2011. All the Patients included in this study were taken from the Out Patient Department/Ward of Nagri Eye hospital.

All the routine examinations were done in detail and record were kept in proforma. Ocular examination was repeated on follow up after 4 weeks and visual acuity were recorded. The final visual acuity was recorded at the final visit after 3 months. History regarding psychosocial/physical & economical well being were also taken and recorded in a proforma with the questionnaire survey. The interview was taken at the final follow up visit.

All the patients were explained in detail in their own vernacular language regarding the nature of trauma and also about the importance of timely intervention. Importance of cooperation from the patients towards frequent visit for follow up was also emphasized. After all the examinations details were clearly explained to the patients and the relatives about the condition of the eye, the treatment and possible visual outcomes. An informed consent was taken to enroll the patient into the study.

#### 3.1. Inclusion Criteria

- All patients with ocular trauma having vision less than 6/18 in the injured eye.

#### 3.2. Exclusion Criteria

The patients having injury with vegetative material and presenting with corneal ulcer:

Patients age below 5 yrs;

Patient whose visual acuity improved more than 6/18 on the final F/U visit;

Patients who missed the follow up;

Patients who are unwilling to participate in the study.

#### 3.3. Examination

Careful and detailed examination of both eyes was conducted along with the general physical examination for other associated injury over any part of the body.

#### 3.4. Ocular Examination

At first the visual acuity was assessed by using Snellen’s multiple optotype chart.

In case where visual acuity was less than 6/60, visual status was measured as counting finger shown to the patient at certain distance in meter. If the patient was not able to count fingers, visual acuity was measured as hand movement close to face, projection of rays and perception of light as well.

Pupillary reaction was assessed for both direct and consensual by using well illuminated torch light. It was also evaluated for RAPD which tests the optic nerve function and retinal function grossly.

A through slit-lamp examination was carried out for both the eyes if not possible it was evaluated with torch light.

Refraction was performed in all the cases wherever relevant at the third visit and best corrected visual acuity was measured and recorded.

A thorough and careful examination of fundus was done by using direct or indirect ophthalmoscope. In the case where fundus was not visible the ultrasonography B-scan was used to evaluate the proper position and shape/abnormality of the retina and surrounding tissues.

Intra-ocular pressure was also measured in all the cases where the wound was sealed and anterior chamber was well formed. It was measured by using Schiottz tonometer or Non contact tonometer.

### **3.5. Investigations Requested**

Routine blood and urine examination;

Conjunctival swabs and vitreous tap (in relevant case);

X-ray orbit to rule out any fracture and lodged foreign body;

CT scan (in relevant case);

USG B-Scan (in relevant case).

The patients were followed up at certain intervals. They were called at the end of first month for follow up and visual acuity was measured. The 2<sup>nd</sup> follow up visit was called at the end of third months and again best corrected visual acuity was taken and recorded.

## **4. Results**

A total 68 eyes of 68 patients with trauma in either eye were included in this study from the outpatient department and/or ward of Nagri Eye Hospital. The data of the patient having history of ocular injury was collected be in the period of October 2010 to September 2011. The ocular injury associated with corneal ulcer was excluded from this study.

### **4.1. Age of Incidence**

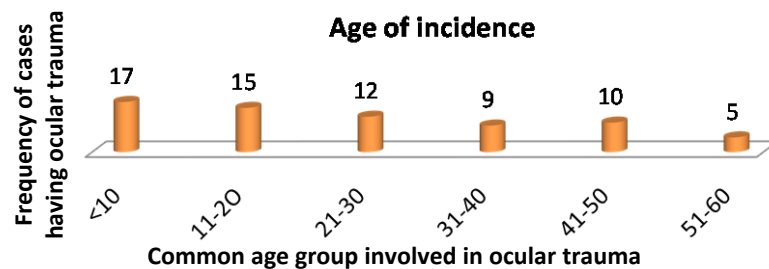
The mean age of incidence of the patients was 25.39 with standard deviation of 16.89. The commonest age group presented with ocular trauma was <10 yrs followed by the 2<sup>nd</sup> decade of life, *i.e.*, 11 - 20 yrs (see **Table 1, Figure 1**).

### **4.2. Sex Distribution**

A majority of patients were Male with mean age  $25.89 \pm 16.55$  in comparison to

**Table 1.** The presentation of different age group.

Age in years	No. of cases (n = 68)	Percentage
<10	17	25
11 - 20	15	22.05
21 - 30	12	17.06
31 - 40	9	13.23
41 - 50	10	14.70
51 - 60	5	7.35

**Figure 1.** Common age group involved in ocular trauma.

Female  $22.89 \pm 19.66$  counting 83.82% and 16.18% respectively (see **Table 2**, **Figure 2**).

### 4.3. Laterality

In this study the majority of the eyes involved were LE which counts for the 55.88% followed by RE 44.12%. There were no cases of bilateral injury with significant visual loss (see **Table 3**, **Figure 3**).

### 4.4. Time to Hospital since Injury

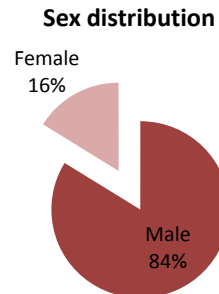
In present study majority of the patients has visited the hospital in between the time period of 24 hrs - 1 wk (57.35%), followed by 23.52% within the time period of <24 hrs and a small group has attended the hospital > 1 wk of time period. Since this hospital is a tertiary center and one of the most famous hospital in state and near around so the patients from remote area as well as from other state visits this hospital and wide area of patients were included in this study (see **Table 4**, **Figure 4**).

### 4.5. Etiological Pattern

This study has shown that the majority of the patients gets their eyes traumatized in industrial work (27.94%) followed by domestic work (26.47%). 19.11% of patients has got the trauma while farming or during agricultural activity. Since children as well as players are also included in this study sports related trauma also accounted for 16.17% and travel related or RTA accounted for 11.76% which was the least among all types off injury (see **Table 5**, **Figure 5**).

**Table 2.** The sex distribution of the patients.

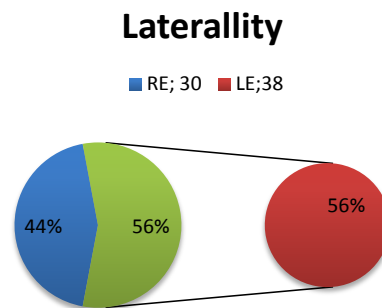
Sex	No. of cases	Percentage
Male	57	83.82
Female	11	16.18



**Figure 2.** The sex distribution of patients.

**Table 3.** Distribution of eye affected.

Eye	No. of cases	Percentage
RE	30	55.88
LE	38	44.11



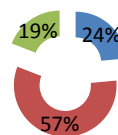
**Figure 3.** The involvement of the eye.

**Table 4.** Time between occurrence of trauma and hospital visit.

Time since injury	No. of patients	Percentage
<24 hr	16	23.52
24 hr - 1 wk	39	57.35
>1 wk	13	19.11

**Time to hospital since Injury**

■ <24 hr ■ 24hr-1 wk ■ >1wk

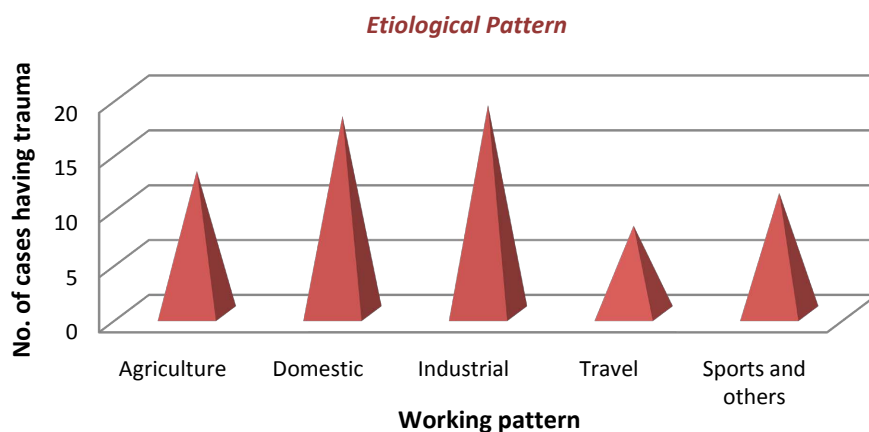


**Figure 4.** Time between the injury and hospital visit.



**Table 5.** The etiological pattern of trauma.

Etiology	No. of cases	Percentage
Agriculture	13	19.11
Domestic	18	26.47
Industrial	19	27.94
Travel	8	11.76
Sports/others	11	16.17

**Figure 5.** The etiological pattern of the trauma.

#### 4.6. Types of Traumatic Agent

According to this study the most common type of ocular trauma was with wooden material (19) followed by metallic (13) and stone (9) where as RTA was only 6 (see **Table 6**, **Figure 6**).

#### 4.7. Visual Recovery to the Patient after Treatment

A comparative study of visual recovery was done between the presenting visual acuity and the final visual out come at the f/u visit after 3 months by using paired t-test; showed that there was marked visual improvement from 1<sup>st</sup> visit to the final visit ( $p$ -value < 0.005).

### 5. Discussion

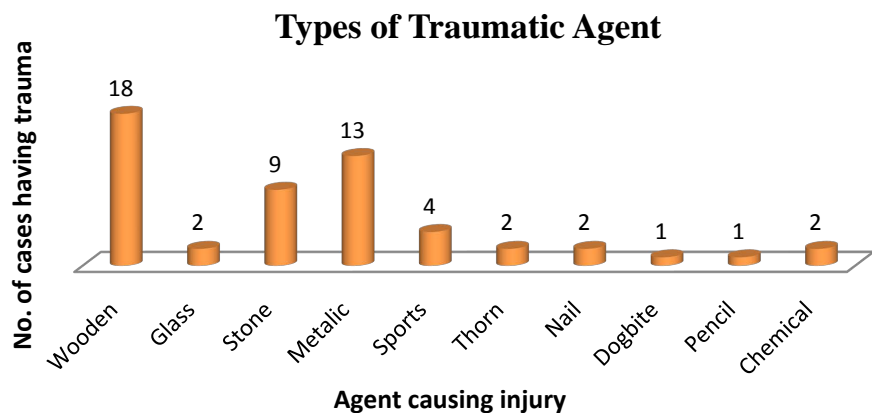
This study has included 68 eyes of 68 patients of all kind of trauma except vegetative type of trauma having corneal ulcer. Total 96 eyes of 95 patients were included in this but due to loss of follow up and unwillingness to participate in the study only 68 cases were finalized.

#### 5.1. Age Incidence

In this study the mean age of patients were 25.39 with standard deviation of 16.89. The commonest age group presented with ocular trauma was <10 yrs followed by the 2<sup>nd</sup> decade of life, *i.e.*, 11 - 20 years (**Table 1**).

**Table 6.** Types of traumatic agent.

Traumatic agent	No. of cases	Percentage
Wooden	19	26.47
Glass	2	2.94
Stone	9	13.23
Metallic	13	19.11
Sports	4	5.88
Thorn	2	2.94
Naill	2	2.94
Dogbite	1	1.47
Pencil	1	1.47
Chemical	2	2.94
Feather	1	1.47
Plastic toys	1	1.47
RTA	6	8.82
Comb	1	1.47
Assault	1	1.47
Fell down staircase	3	4.41

**Figure 6.** Types of traumatic agent.

### Other Study

In a study “A Profile of Penetrating Eye Injuries” had done by Mukherji A.K., Saini J.S., Dabral S.M., which was published in IJO (Indian Journal of Ophthalmology), has shown that 44.9% of patients having injury were within the age of 20 yrs.

Similarly a study done Caroline J. MacEwen, Parul Desai had shown that the commonest age of the patients having ocular injury was 5 - 14.

A similar study done in Nepal by Khatri S.K., Lewis A.E., had shown that the mean age of the study was 28 yrs.

In a study done by Dannenberg, Parver, Brechner had shown that median age of the injured workers was 30 yrs. This study was published in Arch Ophthalmology Journal in June 1992.

## 5.2. Sex Incidence

In present study a great majority of patients was Male with mean age  $25.89 \pm 16.55$  in comparison to Female  $22.89 \pm 19.66$  counting 83.82% and 16.18% respectively (Table 2).

### Other Study

The incidence of ocular injuries was extremely high in males at 83.25% because they are more exposed to occupation and outdoor hazard. This study was a clinical study of ocular injuries and published in IJO (Indian Journal of Ophthalmology), 1979 and was done by Shukla I.M., Verma R.N..

In a similar study entitled "A Profile of Penetrating Eye Injuries" done by Mukherji A.K., Saini J.S., majority of the patients were male (73.17%).

Incidence of trauma was 76.01% males and 23.9% in a study done by Parmar *et al.*, it was a study entitled with Pattern of Ocular injuries in Harayana published in IJO, 1985.

## 5.3. Laterality

In this study, the majority of the eyes involved were LE which counts for the 55.88% followed by RE 44.12%. There were no cases of bilateral injury with significant visual loss (Table 3).

### Other Study

The left eye was most commonly involved (Krishnann, Sreenivasan; ocular injuries in union territory of Pondicher-Clinical presentation, IJO 1988).

All the patients had unilateral injury (Mukherji A.K., Saini J.S.; a profile of penetrating eye injuries, IJO 1984).

## 5.4. Time since Injury

In present study majority of the patients has visited the hospital in between the time period of 24 hrs - 1 wk (57.35%), followed by 23.52% within the time period of <24 hrs and a small group has attended the hospital > 1 wk of time period (Table 4).

### Other Study

31.5% patients presented within 24 hrs, where as 48% of patients presented within first wk and 20.5% presented later than 1 wk (Shukla I.M., Verma R.N.; a clinical study of ocular injuries, IJO 1979).

61.27% sought consultation within 48 hrs, 26.01% sought consultation within 1 wk and 12.71% reported after 1wk (Krishnann and Srinivasan, 1988).

## 5.5. Etiological Pattern

This study has shown that the majority of the patients gets their eyes traumatized in industrial work (27.94%) followed by domestic work (26.47%). 19.11% of patients has got the trauma while farming or during agricultural activity (Table 5).

### Other Study

The most common setting where the ocular trauma occurred was during agricultural labour (Krishnann, Nirmalan *et al.*, ocular trauma in a rural population of southern India 2006, APEDS).

In another study done by Shukla I.M., Verma R.N., had shown that amongst the occupational injuries 46.56% are of agricultural origin.

In contrast to other a similar to this study Duke Elder and Roper Hall series show that industrial and domestic injuries predominate.

### 5.6. Agent Causing Injury

According to this study the most common type of ocular trauma was with wooden (19) material followed by metallic (13) and stone (9) whereas RTA was only 6 (Table 6).

### Other Study

Metallic injuries 33% were the most common followed by trauma with wooden particles 23.18% (Mukherjee A.K., Saini J.S., Dabral S.M., a profile of penetrating eye injuries, Indian J. Ophthal, 1984).

In another study most patients' sustained injury with non-metallic objects 74.56% (Krishnan and Srinivasan, IJO, 1988)

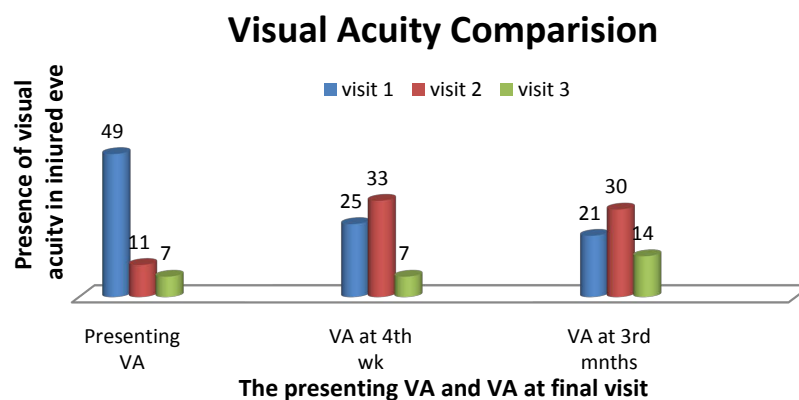
After adjusting for gender, injury with vegetable matter such as a thorn, branch of a tree, plant secretion was the major cause of trauma reported in this population; Arvind computer eye survey, Ophthal, 2004.

### 5.7. Visual Acuity

In this study the presence of visual acuity in injured eye was <3/60 in 25% of cases, 3/60 - 6/60 in 44.12% and >6/60 - 6/18 in 30.88% of patients (Figure 7).

### Other Study

Visual acuity in the injured eye at presentation is an important prognostic factor in the management of ocular injury. The devastating of such trauma can be estimated by the fact that in this study the visual acuity at presentation in 80% of cases was only perception of light.



**Figure 7.** Comparison between the presenting VA with VA at final visit.

Visual acuity at presentation was more than or equal to 6/12 in 1.39%, 3/60 - 6/12 in 6.94% and the light perception to less than 3/60 in 72.22% (Narang S., Gupta V., Simaladhi P., Raj S.; paediatric open globe injury-visual outcome and risk factors for endophthalmitis, IJO, 2004).

Corrected visual gain was 6/12 or better in 44.44% and 6/18 to 6/24 in 22.22% (Parihar J.K., Dash R.G., Vats D.P., Verma S.C., Sahoo P.K., Rodrigues F.E.. management of anterior segment penetrating injuries with traumatic cataract by pentagon approach in pediatric age group: constraints and outcome, IJO, 2000).

Functionally successful outcome VA > 3/60 was achieved in 52.86% and a VA > 6/12 in 21.43% (Narang S. *et al.*, IJO, 2004).

## 6. Conclusions

The eye has been given various protective mechanisms by the nature, despite these injuries may result in blindness. Therefore, all ocular injuries must be treated as emergencies and detailed examination is warranted in even innocuous-looking injuries.

The mean age of incidence of the patients was 25.39 with a standard deviation of 16.89.

The commonest age group presented with ocular trauma was <10 yrs followed by the 2<sup>nd</sup> decade, *i.e.*, 11 - 20 yrs.

A great majority of patients were male with the mean age of 25.89 ± 16.55, in comparison to the female of 22.89 ± 19.66 accounting for 83.82%.

Left eye involved in the majority of which accounts for 55.88%.

The majority of the patients have visited the hospital between the time period of 24 hrs - 1 wk (57.35%), followed by 23.52% within the time period of <24 hrs and a small group has attended the hospital > 1 wk of the time period.

The majority of the patients get their eyes traumatized in industrial work (27.94%) followed by domestic work (26.47%). 19.11% of patients have got the trauma while farming or during agricultural activity.

The most common type of ocular trauma was with wooden (19) material followed by metallic (13) and stone (9) whereas RTA was only 6.

Blunt types of trauma were most frequent accounting for 42.64% followed by combined blunt and perforating 32.35%.

A comparative study of visual recovery was also done between the presenting visual acuity and the final visual outcome after 3 months by using paired t-test, which showed there was marked visual improvement from 1<sup>st</sup> visit to the final visit (*p*-value < 0.005).

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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