Original Article

Relationship between Presenting and Final Visual Acuity in Penetrating Corneal Injury Patients in a Tertiary Eye Hospital of Bangladesh

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Abstract

Background: Penetrating corneal injury is a full thickness penetration of the cornea. Early management can regain useful final visual acuity and can prevent blindness by reducing complications. **Objective:** To evaluate the relationship between presenting & final visual acuity in penetrating corneal injury patients. **Methods:** This prospective observational study was aimed to evaluate the relationship between the presenting and final visual acuity (VA) of penetrating corneal injury patients, where 104 eyes were studied in National Institute of Ophthalmology & Hospital (NIO&H) from the year 2021 to 2023. Detailed ophthalmic examinations of the patients were done including the presenting visual acuity, anterior and posterior segment. Follow up was done after 7 days, after 1 month, 3 months and 6 months with best corrected final VA at 6th month. **Results:** This study showed the median (IQR) age for the subjects was 27.0 (20.0-40.0) years. There were 89 males (85.6%) and 15 females (14.4%). Majority of the patients (57.7%) came within 24 hours of injury. Majority of the patients (61.5%) presented with mono ocular blindness (VA<3/60), where 1% presented with normal or mild visual impairment. Majority were caused by sharp objects (61.5%) followed by wooden stick (15.4%), road traffic injury (10.6%) and metallic objects (7.7%). Finally, 58.9% patients regained Final VA 6/6-6/18 and 11.6% were blind. In the 6 months follow up period, 22.1% patients had complications which included traumatic cataract, vitreous hemorrhage, endophthalmitis, retinal detachment and phthisis bulbi. Factors affecting poor final VA were poor initial VA (p=<0.001), older age (p=0.005), delayed presentation (p=0.016), central corneal injury (p=0.008), larger size of injury (p=0.001), and presence of complications (p=<0.001). **Conclusion:** Better initial visual acuity results in a favorable final VA. Central corneal injury, older age, large sized injury, delayed presentation and presence of complication cause poor final VA.

Keywords: Penetrating corneal injury, Presenting visual acuity, final visual acuity.

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Introduction

Ocular trauma is one of the leading causes of ocular morbidity.[1] As the most anterior structure, cornea is the most vulnerable structure to ocular trauma[2] which lies in Zone I according to Birmingham Eye Trauma Terminology System (BETTS) classification.[3]

Penetrating corneal injuries (PCI) lead to formation of corneal opacity and scar which may cause decreased visual acuity due to visual axis involvement even after healing.[4] In adults, the most common causative factors are road traffic accidents, assault and fall. On the other hand, sports injuries account for 27% of all eye trauma in children which requires hospitalization indicating that, the cause of ocular injury is dependent on patient's age and occupation.[5]

Corneal injury accounts for significant visual loss in most of the patients, thus it has been a

serious public health problem. In USA, 3.81 penetrating eye injury occur per 100, 000 in a year and in Turkey, the incidence of OGI in adults was 3.40 per 100,000.6 Worldwide about 1.6 million people become blind because of ocular injury. Moreover, there are bilateral impairment of vision cases accounts for 2-3 million, where 19 million has unilateral impairment. Ocular trauma is the most common cause to be unilaterally blind. It has become so significant because the morbidity due to visual impairment or vision loss reduces the quality of life of the affected person.[7] In South Asian region, the prevalence of eye injury is high.[8]

The primary surgical repair is done for the structural integrity of the cornea at the earliest possible chance. A successful surgical repair can achieve a significant visual outcome.[1] But sometimes the visual outcome is not satisfactory even after the advancement of ocular surgery. It depends on the presenting VA, size of the injury, extent of damage, other structural involvement, duration of injury, accuracy of initial assessment, early diagnosis, good ocular first aid and early referral.[5]

Several studies were held in different countries worldwide, which evaluated demographic characteristics and poor prognostic factors including poor presenting visual acuity[9-13], older age[9], delayed presentation[2,12,14], zone of injury[2, 11-13], size of injury, traumatic cataract[15], retinal detachment (RD), globe rupture[9,11] vitreous haemorrhage[11], phthisis bulbi, endophthalmitis[16] etc.

In National Institute of Ophthalmology & Hospital (NIO&H), every day on an average, around[10-15] cases of ocular trauma are presented, more than half of which includes corneal injury. This study will help to evaluate the corneal injuries and their visual outcomes to determine whether there any contributing factor related to final visual outcome or any relationship between presenting & final VA. Thus, it will be useful in assuming the prognosis, doing pre-operative counselling of possible outcome, designing the specific interventions for better visual outcome and preventing complications.

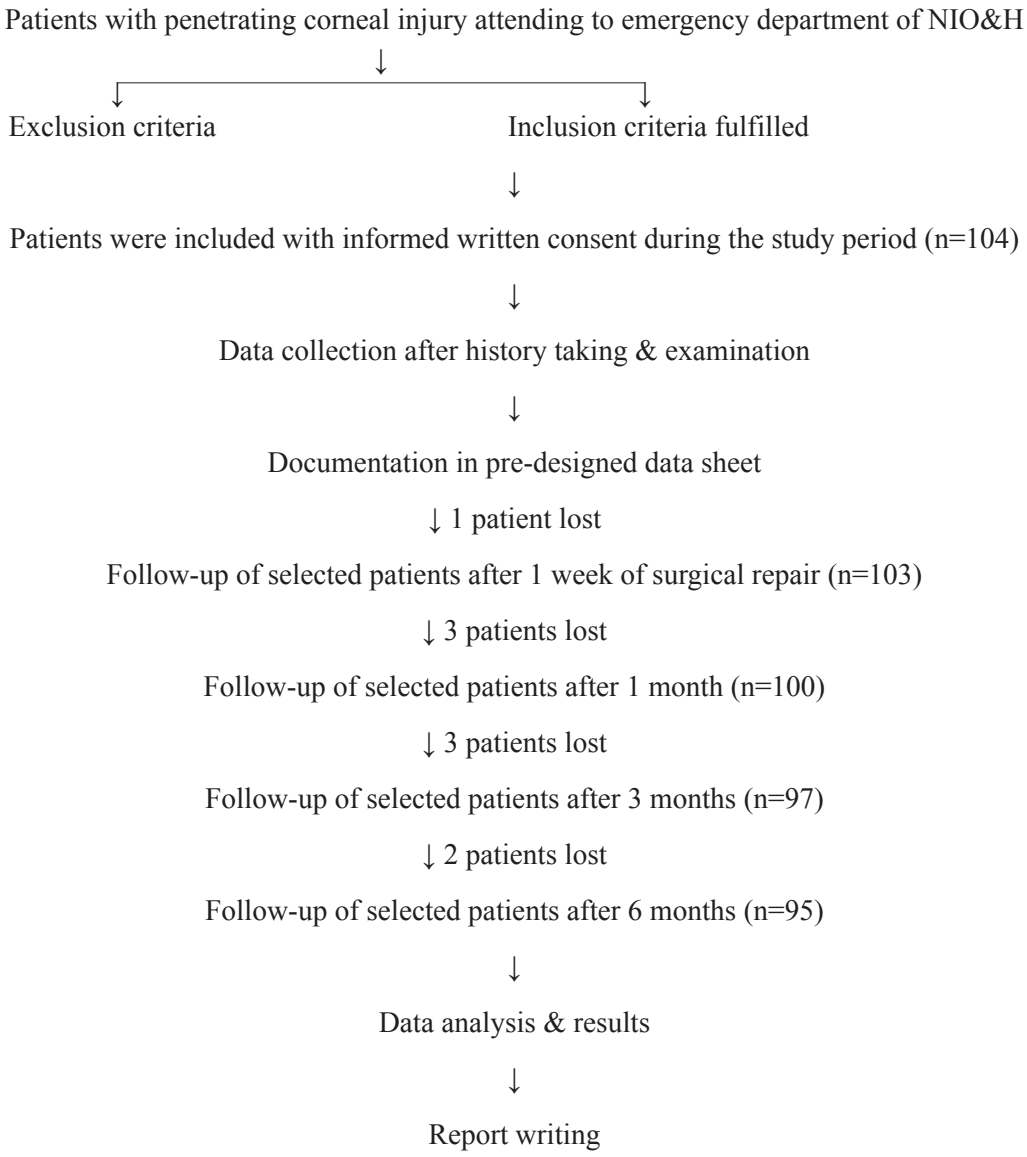
Therefore, present study evaluated the relationship between presenting & final visual acuity in penetrating corneal injury patients.

Materials and method

The research protocol of the prospective observational study was approved by the Ethical Review Committee of National Institute of Ophthalmology and Hospital (NIO&H). Patients attending to Emergency Department of NIO&H, Dhaka with penetrating corneal injury involving only the zone I were included in the study by purposive sampling technique from the year 2021 to 2023. Patients of corneal injury with iris prolapse, corneoscleral injury, deeper structure involvement or with past ocular disease or past injury in affected eye were excluded. The youngest patient who could co- operate to assess visual acuity by Snellen's chart was 10 years old. Calculated sample size was 108 including non-response rate. Within the time frame 104 patients were available and included into the study. Informed written consent was obtained from the patients or attendants and assent form was obtained from adolescents. Detailed ophthalmic examinations including visual acuity, pupillary light reflex, ocular motility, ocular adnexa, size and location of corneal injury, associated ocular injury, sign of any previous trauma or surgery, iris, anterior chamber, lens, intra-ocular pressure etc. were done carefully. Preoperative counselling regarding possible visual outcome or complication and surgical management were done accordingly. Post-operative follow-up given after 1 week, 1 month, 3 months and 6 months of repair.

Visual acuity was recorded on Snellen's distant VA chart. Central corneal injury was defined as injury involving the central 4 mm of cornea in the zone I where injury outside the central 4 mm of cornea up to limbus was considered as peripheral corneal injury. Blindness was defined as Snellen's visual acuity worse than 3/60 and visual acuity was categorized according to World Health Organization (WHO) classification of VA.[16] Fundus evaluation was done with 90 D condensing lens where possible. Cataract surgeries were done with intra-ocular lens implantation in patients who developed traumatic cataract during the follow up periods. Final follow up (6th month) included Best Corrected VA (BCVA). B-scan USG was advised in selected patients. If any complication detected, patients were referred to the related

sub specialists to treat the complications in different follow up periods. On 1st week, one patient lost, on first month 3 more patients were lost, on 3rd month 3 more patients were lost and on 6th month follow-up 2 more patients were lost. Ninety-five patients could be followed up and analyzed at the end of the 6th month. All the data were recorded in a pre-designed data collection sheet. The study flow was-



Median with interquartile range for continuous variables and frequency distributions for categorical variables was used to describe the characteristics of the total sample. Association of categorical data were reviled by Fisher exact test. Baseline visual acuity was compared to BCVA at 6th month by McNemar test. Association of continuous data were reviled by Mann Whitney U test. A p-value less than 0.05 was considered statistically significant in two-tailed test.

Result:

Table I: Distribution of patients by baseline characteristics (n=104)

Baseline Characteristics	Frequency (percentage)
Sex	
Male	89 (85.6)
Age	
Median (IQR)	27.0 (20.0, 40.0)
Residence	
Rural	60 (57.7)
Occupation	
Student	30 (28.8)
Service holder	20 (19.2)
Businessman	14 (13.5)
Farmer	11 (10.6)
Housewife	8 (7.7)
Others	21 (20.1)
Laterality	
Right	62 (59.6)
Left	42 (40.4)
Duration	
Within 24hrs	60 (57.7)
Beyond 24hrs	44 (42.3)
Zone	
Central	27 (26)
Peripheral	77 (74)
Size	
Up to 5mm	79 (76)
>5mm	25 (24)
Cause	
Sharp object	64 (61.5)
Wooden	16 (15.4)
RTA	11 (10.6)
Others	13 (12.5)

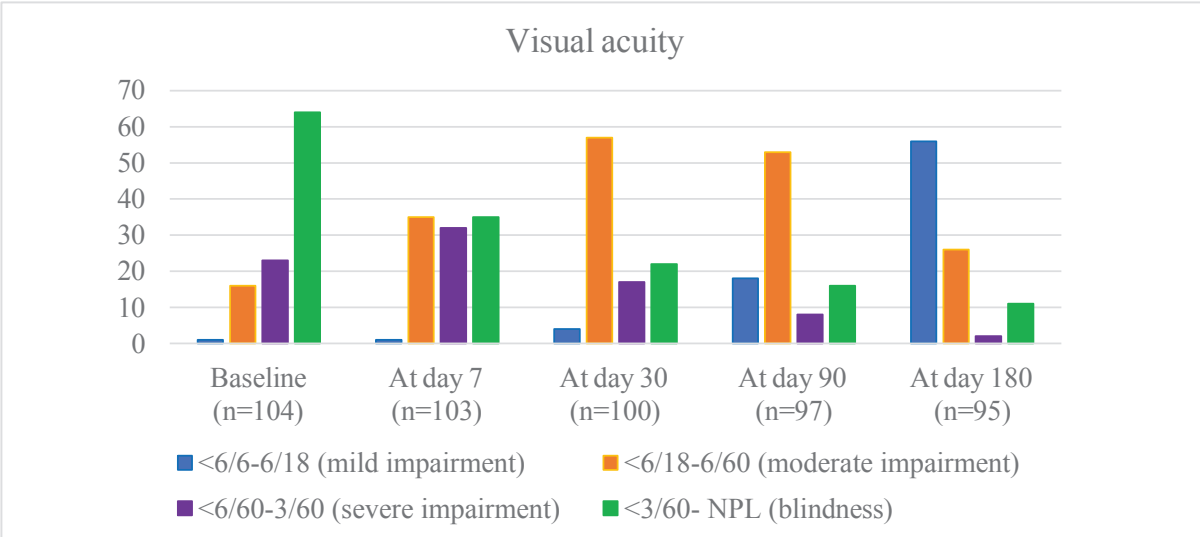


Figure 1: Distribution of patients by visual acuity at different time points

Complications	Frequency (n)	Percentage (%)
No complication	74	77.9
Complications		
Traumatic cataract	6	6.3
Vitreous hemorrhage	6	6.3
Endophthalmitis	3	3.2
Phthisis bulbi	3	3.2
Retinal Detachment	2	2.1
Others	4	4.2

Multiple response

Table III: Association of final BCVA at 6th month with different independent variables (n=95)

Criteria	BCVA at 6th month		p value
	6/6-6/18 to <6/60-3/60 (Mild to severe impairment)	<3/60- (Blindness)	
Age (in years)	24.5 [19.7, 35.0]	40.0 [25.0, 45.7]	**0.005**[a]
Sex			
Male	75 (89.3%)	9 (10.7%)	0.611[b]
Female	9 (81.8%)	2 (18.2%)	
Duration (in hours)	17.5 [6.7, 29.0]	31.0 [20.7, 70.5]	**0.016**[a]
Injury to presentation			
Zone			
Central (within 4 mm)	19 (73.1%)	7 (26.9%)	**0.008**[b]
Peripheral (beyond 4 mm)	65 (94.2%)	4 (5.8%)	
Size (in mm)	4.0 [3.0, 5.0]	5.0 [4.5, 6.4]	**0.001**[a]
VA at baseline			
6/6-6/18 to <6/60-3/60	37 (97.4%)	1 (2.6%)	**<0.001**[c]
<3/60- NPL	47 (82.5%)	10 (17.5%)	
Complications			
No complication	74 (100.0%)	0 (0.00%)	**<0.001**[b]
Complication	10 (47.6%)	11 (52.4%)	

a=Mann Whitney U test, b=Fisher Exact test, c- McNemar test bold indicates significant p value

Table: Association of final BCVA at 6th month with complications (n=95)

Criteria	BCVA at 6th month		p value
	6/6-6/18 to <6/60-3/60 (Mild to severe impairment)	<3/60- NPL (Blindness)	
Retinal detachment			
Absent	84 (90.3%)	9 (9.7%)	**0.012[a]**
Present	0 (0.0%)	2 (100.0%)	
Endophthalmitis			
Absent	84 (90.3%)	8 (8.7%)	**0.001[a]**
Present	0 (0.0%)	3 (100.0%)	
Phthisis bulbi			
Absent	84 (90.3%)	8 (8.7%)	**0.001[a]**
Present	0 (0.0%)	3 (100.0%)	

a= Fisher Exact test, bold indicated significant p value

Discussion:

This prospective observational study aimed to evaluate the relationship between the presenting & final visual acuity of penetrating corneal injury patients. This study found that there was significant reduction of blindness (visual acuity <3/60- NPL) after 6 months of treatment. At the end of 6 month, near about one fourth patients had complications which included traumatic cataract, vitreous hemorrhage, retinal detachment, endophthalmitis and phthisis bulbi. Rate of blindness

was significantly higher in older age group, higher duration of injury, larger size of the lesion, initial visual acuity visual acuity <3/60-NPL and patients who developed complications. In this study, the median age of the patients was 27.0 years, most were in 20-29 years group where in Japan, a higher mean age was found.[11] This was similar to some recent studies[17,18] and not similar to some.[1,10] The variation may be related to inter-population variances.[11]

In this study, penetrating corneal injury was more common in male with a male to female ratio of 6:1. Similar finding was described in other studies.[11,16,19,20] Male are more engaged in risky behaviour and more physically demanding jobs than female.

Younger patients had better visual outcome than older like most of the studies[9] where students were the most commonly affected group as they were involved in part-time job causing more risk of being injured. It is consistent with some studies.[17,21] This study was confined to penetrating corneal injury with no deeper structural involvement. As occupational injuries are more severe causing deeper structural involvement, so this study was not consistent with some reports.[16]

Like most of the studies, we also found majority had injury in the right eyes as dextro-manual predominance.[22,23]

Our study observed that prolonged duration between injury and presentation was

significantly related to poor visual outcome. In Thailand, similar result was found.[19] Delayed presentation may cause the wound margin to swell more or increases the risk of infection, causing wound dehiscence.

Our findings also showed that the zone of injury was significantly related to the visual outcome. In Lithuania[20] and India[13], significantly poor VA has been seen in wounds affecting zone 3 in comparison to zones 1 or 2 involvement. Some other studies reported that, there is a significant

association between the posterior extension of the wound and a worse final VA.[24-26] As our study considered only zone I injury, better visual outcome has been seen in peripheral involvement than the central.

Smaller injuries had a statistically significant better VA than of larger length. This was in accordance with several previous.[11,24,27] A larger injury indicates more significant tissue damage and risk of posterior involvement. These data revealed that the extent of the injury had both therapeutic and prognostic ramifications, being strongly associated with a worse visual outcome.

In this study, better initial VA was significantly related to better final VA which indicated that initial VA was a crucial factor for final outcome as there is lesser tissue damage. It was consistent with many study reports.[9-13,19,24,26,28,29]

During 6 months follow up, 22.1% patients had complications including traumatic cataract, retinal detachment, vitreous hemorrhage, endophthalmitis, phthisis bulbi etc. supported by many reports from different parts of the world.[20,29,30] Traumatic cataract is the most frequent vision impairing complication which can occur at any time from day one to several years after injury.

In this study, only zone I injuries were considered excluding the iris prolapse. So, lower risk of endophthalmitis had been found in comparison to other studies.[16,20]

This study found that, the presence of complication (RD, endophthalmitis and phthisis bulbi) significantly affects final VA. Previously it was reported that traumatic cataract[15], RD[9,11,24,30,] endophthalmitis and phthisis bulbi[16,20] was associated with poor prognosis. Some studies[11,20,31] found vitreous hemorrhage is a predicting factor for poor visual outcome which we didn't.

As the surgeries were not done by single surgeon rather by multiple surgeons, so the quality of repair may interfere the result and long-term follow up could not be possible regarding final visual outcome, as corneal remodeling may occur up to 3-4 years of repair. These were the limitation of the study.

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