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Original Article

Factors Affecting Visual Outcome in Patients with Penetrating Corneal Injury

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ABSTRACT

Objective: *To assess the visual acuity in patients with penetrating corneal injury with or without iris prolapse.* ***Methods & Materials:*** *This prospective observational study was conducted over 60 eyes with penetrating corneal injury with or without iris prolapse in National Institute of Ophthalmology & Hospital from October 2022 to September 2023. Detailed ophthalmic and systemic examinations of the patients was done with special attention to assessment of presenting visual acuity. All repairs were done under general anaesthesia with all aseptic precaution by multiple surgeons. Follow up was done on first post operative day, after 7 days, after 1 month and after three months.* ***Results:*** *This study shows the mean age for subjects with iris prolapse is 36.23± 11.64 years and without iris prolapse were 35.30±11.48 years. There were 19 male subjects (63.3%) with iris prolapse while there were 24 male subjects (80.0%) in the group without iris prolapse. For the female subjects, there were 11 (36.7%) with iris prolapse and 6 (20.0%) without irish prolapse. In the group with irish prolapse, 36.7% of injuries were caused by sharp objects, while 40% of injuries were in without irish prolapse group. The Best Corrected Visual Acuity (BCVA) of the study subjects after 3 months surgery, majority 88.9% were 6/6-6/36 in without irish prolapse group but 10.7% were 6/6- 6/36 in with iris prolapse group in 3 months follow up. Analysis revealed that statistically significant (P<0.001) better outcome of visual acuity (Log MAR) without irish prolapse than with irish prolapse at 3 month follow up. Lower level of Log MAR chart in without irish prolapse group than with irish prolapse group which was 0.57±0.20 versus 1.57±0.90 respectively. The difference was statistically significant between with and without irish prolapse group (P<0.001). During follow up of 3months, 35.8% patients had complication in iris prolapse group and 11.1% patients had complication in without iris prolapse group included traumatic cataract (25%), retinal detachment (17.9%), Endopthalmitis (3.6%) and some other (7.1%) in iris prolapse group, on the other hand traumatic cataract (11.1%), retinal detachment (3.7%) in without iris prolapse group.* ***Conclusion:*** *This study shows best corrected visual acuity (BCVA) revealed that iris prolapse had a higher proportion of poor visual outcomes, with a higher percentage reporting a BCVA of hand movement or 6/60. These findings have implications for clinical practice, highlighting the importance of prompt intervention and comprehensive follow-up care in patients with penetrating corneal injuries.*

Keywords: *Visual Outcome, Penetrating Corneal Injury, phthisis bulbi*

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INTRODUCTION

The cornea has high transparency. It is slightly oval shaped. The dimension measuring about 11.7 mm horizontally x 10.6mm vertically. There is a transitional zone, where it is continuous with the sclera, known as the limbus or corneoscleral junction. [1] The most important functions of cornea are, protection of intra ocular structures protection of the eye against infections by its avascularity, contribution in two-third of the refractive power of the eye. Corneal refractive index is 1.376. The thickness of central cornea in normal eyes is 551 to 565, thicker in periphery. This thickness decreases with age. [2] Multiple soft tissue injuries to the lid, globe, or orbital area may result from severe ocular trauma. It is the most frequent cause of blindness and impaired monocular vision. The majority of ocular trauma is accidental and has an age-specific pattern. In the age range of 6 to 10 years, there is a clear predominance. Males are particularly affected because of their aggressive and adventurous nature. The causes are numerous, and they

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frequently change geographically and in accordance with socioeconomic status. According to Negrel and Thylefors, 19 million people have unilateral blindness or low vision, 2.3 million have bilaterally low visual acuity, and 1.6 million are blind as a result of ocular injuries. Compared to blunt injuries, penetrating injuries are known to have a poor prognosis. [3] The type of injury, the extent of damage, and the presence or absence of secondary infections from retained intraocular foreign bodies all affect the visual outcomes of ocular injuries. Penetrating injuries typically result in worse visual outcomes than blunt injuries. Penetrating injuries require surgical intervention to restore structural integrity, whereas non-penetrating corneal and ocular surface injuries typically respond to conservative management. [4] Worldwide approximately 1.6 million people become blind due to ocular trauma. Moreover, there are 2-3 million bilaterally visually impaired where 19 million unilaterally. Ocular trauma is the most common cause of unilateral blindness. It has become so significant because the morbidity due to visual loss or impairment reduces the quality of life of the affected person. [5] On examining the injured eye with slit lamp bio-microscopy, signs of a full-thickness corneal laceration or penetration include decreased visual acuity, prolapsed Iris, hyphema, microhyphema, and a shallow anterior chamber. Leaking of aqueous humor from the anterior chamber during fluorescein test suggests corneal penetration is there. This examination is named Seidel's test. But in case of small laceration, Seidel test may be negative. [6] This study has undertaken to evaluate the corneal injuries and their visual outcomes to determine whether there have been any changes in the causes and outcome of these injuries. So that, this would be useful in assuming the prognosis and designing the specific interventions for preventing the injuries and improving their management

METHODS & MATERIALS

Study design: The study was a prospective observational study.

Place of study: This study is carried out at National Institute of Ophthalmology & Hospital, Sher-E-Bangla Nagar, Dhaka, Bangladesh.

Study period: From October 2022 to October 2023.

Study population: Patient having penetrating corneal injury with or without Iris prolapse attending in National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh.

Sample size: $n=[P_1(1-P_1) +P_2(1-P_2)/(P_1-P_2)^2]x(Z_\alpha+Z_\beta)^2$

Therefore, 36 patients required in total. Considering 10% non-response rate the final sample size came to 40. Due to availability of patients and to increase the power of the study, 60 sample will be taken (30 in each group).

Inclusion criteria

- All the patients of both gender having penetrating corneal injury with or without Iris prolapse aged at or above 15 years, attending the emergency department of NIO&H.

Exclusion criteria

- Patient with ocular injury involving structures other than corneal penetrating injury with or without Iris prolapse.
- Patient having history of any ocular surgery or trauma.
- Patients suffering from ocular surface or intraocular disease like cataract, glaucoma, vitreous haemorrhage, retinal detachment.
- Patients enrolled in other study group in last 06 months.
- Patients non-compliant to follow up.

Procedures of collecting data: Data was collected from the patient at Emergency Department of NIO&H in a data collection sheet with questionnaire and in the follow up rooms. Patients detailed ophthalmic and systemic examinations with special attention to assessment of presenting visual acuity. All repair was done under general anaesthesia with all aseptic precaution by a competent surgeon. Follow up was done on first post operative day, after 7 days, after one month, after three months. Anterior segment evaluation with special attention to assessment of visual acuity was done in each follow up visit.

Procedure of data analysis and interpretation: Data was checked, cleaned and edited properly before analysis. Statistical analysis was carried out by using SPSS (Statistical Package for the Social Sciences) v26.0 software. Descriptive statistics were used for the interpretation of the findings. The result was presented in tables, figures and diagrams etc. Arithmetic mean and standard deviation were used to describe the quantitative variables and frequency distributions for categorical variables. Association of categorical data were assessed by using Chi square test, Fisher exact test while association of continuous data were assessed by using independent sample t test. Here all p-value were two sided and $p<0.05$ considered significant.

RESULTS

Table – I: Demographic characteristics of the study subjects (*n*=60)

Age in years	With iris prolapse (n=30)		Without iris prolapse (n=30)		P value
	No	%	No	%	
16-20	1	3.3	2	6.7	0.715[a]
21-30	12	40.0	11	36.6	
31-40	6	20.0	8	26.7	
41-50	7	23.3	6	20.0	
51-60	4	13.3	3	10.0	
Mean±SD	36.23±11.64		35.30±11.48		0.756[b]
Sex					

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Male	19	63.3	24	36.7	
Female	11	80	6	20	
Occupational status					
Garments worker	11	36.7	8	26.7	
Farmer	6	20.0	5	16.7	
Student	4	13.3	6	20.0	0.825
Businessman	6	20.0	6	20.0	
Others	3	10.0	5	16.7	

Data were analyzed using fisher exact test[a] and independent student t test[b]

Table-I shows maximum (40%) were age group 21-30 years in with iris prolapse group and 36.6% were without iris prolapse group. The mean age for subjects with iris prolapse is 36.23±11.64 years and without iris prolapse was 35.30±11.48 years. The difference was statistically not significant between two groups (P>0.05). Shows in the group with Iris prolapse (n=30), there were 19 male subjects, accounting for 63.3% of the total, while there were 24 male subjects (80.0%) in the group without Iris prolapse. For the female subjects, there were 11 (36.7%) with Iris prolapse and 6 (20.0%) without Iris prolapse. Maximum patients were garments worker which was 36.7% in with iris prolapse group and 26.7% in without iris prolapse group. The P value for this comparison is 0.825, suggesting that the difference is not statistically significant.

Table – II: Size of injury of the study subjects (*n*=60)

Size	With iris prolapse (n=30)		Without iris prolapse (n=30)		P value
	No	%	No	%	
1-5 mm	5	16.7	13	43.3	0.206
>5-10 mm	9	30.0	11	36.7	
>10 mm	16	53.3	6	20.0	

Data were analyzed using fisher exact test

Table-II shows maximum (53.3%) size was >10 mm in with iris prolapse group but maximum (43.3%) size was 1-5 mm without iris prolapse. The P value for this comparison is 0.206, indicating that the difference is not statistically significant.

Table – III: Duration of injury, Injurious agent and zone of injury subjects (*n*=60)

Duration of injury (hours)	With iris prolapse (n=30)		Without iris prolapse (n=30)		P value
	No	%	No	%	
0-6	4	13.3	3	10.0	0.874
>6-12	9	30.0	12	40.0	
>12-24	8	26.7	7	23.3	
>24-48	9	30.0	8	26.7	
Injurious agent					
Sharp object	11	36.7	12	40.0	0.308
Metallic object	10	40.0	7	23.3	
RTA	4	13.3	3	10.0	
Wooden stick	3	10.0	6	26.7	
Other	2	6.7	2	6.7	
Zone of injury					
Centeral	6	20	5	16.7	
Peripheral	24	80	25	83.3	

Data were analyzed using fisher exact test

Table-III shows maximum (30%) were >6-12 hours duration of injury in with iris prolapse and 40% were without iris prolapse group. The P value for this comparison is 0.874, indicating that the difference is not statistically significant. Shows in the group with iris prolapse (n=30), there were 11 subjects (36.7%) injured by a sharp instrument, while there were 12 subjects (40%) without iris prolapse injured by the same agent. The P value for this comparison is 0.308, suggesting that the difference is not statistically significant. Majority (80%) were peripheral and 20% were central in with iris prolapse group. On the other hand, majority (83.3%) were peripheral and 16.7% were central in without iris prolapse group.

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Table – IV: Visual acuity at baseline of the study subjects (*n*=60)

Visual acuity	LogMAR	With iris prolapse (n=30)		Without iris prolapse (n=30)	
		No	%	No	%
6/6	0	0	0.0	0	0.0
6/9	0.18	0	00	0	00
6/12	0.30	0	0.0	0	00
6/18	0.48	0	0.0	1	3.3
6/24	0.60	1	3.3	1	3.3
6/36	0.78	1	3.3	2	6.7
6/60	1.00	7	23.3	9	30.0
Counting finger	2	7	23.3	7	23.3
Hand movement	3.00	11	36.7	9	30.0
PL/PR	3.5	3	10.0	1	3.3

Data were analyzed using fisher exact test

Table-IV shows at the 6/36 vision level, 3.3% of subjects with Iris prolapse and 6.7% of subjects without it had this level of vision. At 6/60 vision, 23.3% of subjects with Iris prolapse and 30.0% of subjects without it had this level of vision. Hand movement was observed in 36.7% of subjects with Iris prolapse and 30.0% of subjects without it, with a LogMAR value of 3.00. Lastly, 10% of subjects with Iris prolapse and 3.3% of subjects without it had PL/PR vision with a LogMAR value of 3.5.

Table – V: Visual acuity at 1st week of the study subjects (*n*=60)

Visual acuity	LogMAR	With iris prolapse (n=30)		Without iris prolapse (n=30)	
		No	%	No	%
6/6	0	0	00	0	00
6/9	0.18	0	0	0	00
6/12	0.30	0	00	1	00
6/18	0.48	1	3.3	2	3.3
6/24	0.60	2	6.7	5	16.7
6/36	0.78	4	13.3	7	23.3
6/60	1.00	10	33.3	8	26.7
Counting finger	2	3	10.0	2	6.7
Hand movement	3.00	8	26.7	5	16.7
PL/PR	3.5	2	6.7	0	00

Data were analyzed using fisher exact test

Table-V shows maximum at 6/60 vision, 10 (33.3%) subjects with Iris prolapse and 8 (26.7%) subjects without iris prolapse achieved this level. For "Counting finger" vision, 3 (10.0%) subjects with iris prolapse and 2 (6.7%) subjects without iris prolapse reached this level. "Hand movement" vision (LogMAR 3.00) was observed in 8 (26.7%) subjects with iris prolapse and 5 (16.7%) subjects without iris prolapse. The category "PL/PR" with a LogMAR value of 3.5 was seen in 2 (6.7%) subjects with iris prolapse, while none of the subjects without iris prolapse reached this level.

Table – VI: Visual acuity at 1 month of the study subjects (*n*=57)

Visual acuity	LogMAR	With iris prolapse (n=29)		Without iris prolapse (n=28)	
		No	%	No	%
6/6	0	0	00	0	00
6/9	0.18	0	00	0	00
6/12	0.30	0	00	1	3.6
6/18	0.48	1	3.4	5	17.9
6/24	0.60	1	3.4	11	39.2
6/36	0.78	3	10.3	8	28.5
6/60	1.00	11	37.9	2	7.1
Counting finger	2	8	27.5	1	3.6
Hand movement	3.00	4	13.7	0	00
PL/PR	3.5	1	3.4	0	00

Data were analyzed using fisher exact test

Table-VI shows majority (89.2%) were 6/6-6/36 in without iris prolapse group but majority (82.5%) were 6/60-PL/PR in with iris prolapse group in 1 month follow up. Analysis revealed that statistically significant (P<0.001) better outcome of visual acuity (LogMAR) without Iris prolapse than with Iris prolapse at 1 month follow up.

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Table – VII: BCVA at 3 months of the study subjects (*n*=55)

Visual acuity	LogMAR	With iris prolapse (n=28)		Without iris prolapse (n=27)	
		No	%	No	%
6/6	0	0	00	0	00
6/9	0.18	0	0	1	3.7
6/12	0.30	1	00	3	11.1
6/18	0.48	1	3.6	7	25.9
6/24	0.60	2	7.1	11	40.8
6/36	0.78	2	7.1	2	7.4
6/60	1.00	9	32.1	3	11.1
Counting finger	2	8	32.1	0	00
Hand movement	3.00	4	14.2	0	00
PL/PR	3.5	1	3.6	0	00

Data were analyzed using fisher exact test

Table-VII shows majority 88.9% were 6/6-6/36 vision in without iris prolapse group but 17.8% were 6/6-36 group in with iris prolapse group in 3 months follow up. Analysis revealed that statistically significant (P<0.001) better outcome of visual acuity (LogMAR) without Iris prolapse than with Iris prolapse at 3 month follow up.

Table – VIII: Comparison of patient's visual acuity by LogMAR

Visual Acuity	With Iris prolapse (n=30) Mean±SD	Without Iris prolapse (n=30) Mean±SD	P value
Baseline	2.19±0.96	1.87±0.96	0.198
1st week	1.72±1.05	1.22±0.88	0.050
1 month	1.54±0.82	0.69±0.30	0.001
3 months	1.57±0.90	0.57±0.20	0.001

Data were analyzed using 't' test

Table-VIII shows patients with iris prolapse group, at baseline, the mean visual activity was 2.19 ± 0.96 while patients without iris prolapse group, the mean VA was 1.87 ± 0.96. In 3rd month, patients with iris prolapse group VA reduced 1.57 ± 0.90 while in without iris prolapse group, the mean VA was 0.57 ± 0.20. The difference was statistically significant between with and without iris prolapse group (P <0.001).

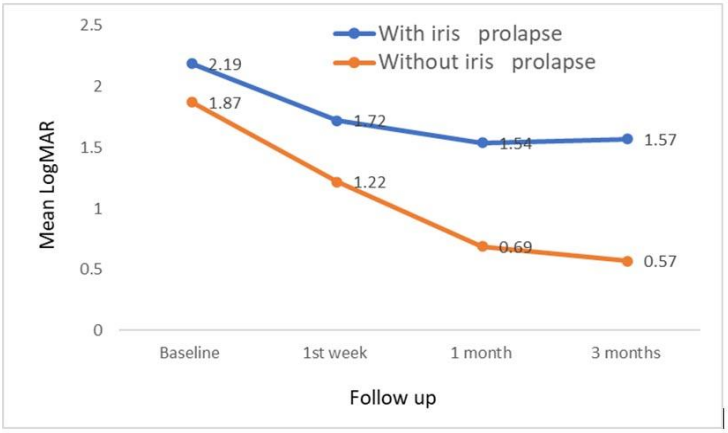

Figure – 1: Distribution of patient's visual acuity by logMAR

Figure-1 shows iris prolapse group, at base line, the mean VA was 2.19 which reduced to 1.54 at one month. Finally it reduced to 1.57. On the other hand without iris prolapse group, at base line, the mean visual activity was 1.87 which reduced to 0.69 at one month. finally, it reduced to 0.57.

Table – IX: Distribution of patients by complications (*n*=55)

Complications	With Iris prolapse (n=28)		Without Iris prolapse (n=27)		P value
	No	%	No	%	
No complication	18	64.2	24	88.9	
Complication	10	35.8	3	11.1	0.001
Traumatic cataract	7	25.0	3	11.1	
Retinal Detachment	5	17.9	1	3.7	
Endophthalmitis	1	3.6	0	00	
Others	2	7.1			

Data were analyzed using fisher exact test

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Table-IX shows 64.2% of patients with iris prolapse have no complications, while 88.9% of patients without iris prolapse have no complications. The P-value is 0.001, indicating a highly significant difference.

DISCUSSION

Penetrating corneal injury is a well-established cause of preventable visual loss. This study assesses the visual acuity in patients with penetrating corneal injury with or without Iris prolapse. In this study, most of the patients were 21-30 years of age. The present study purposively included patients who were cooperative and whose visual acuity could be evaluated. As, it was difficult to measure the visual acuity in case of children, so patients with these age group were excluded. Hence, the proportion of 21-30 years age was maximum which matched the study of Zungu et al. [8] This study revealed that most of the patients were male in both group which is consistent with findings from the majority of similar studies. [9-12] Most of the injury done by sharp objects and metallic objects were found in iris prolapse and without iris prolapse group. Similar finding has been reported in previous studies. [13] But in Raiturcar et al., [14] established those ocular injuries associated with motor vehicle accidents and in Kaur et al., [15] said that the most common cause of injury was RTA (30%) followed by injury due to wood (12%) and sticks (10%). Several factors were found associated with final visual outcome. Younger patients had better visual outcome than older ones. The Australian study of Kong et al., [16] also found younger patients had better visual outcome than older ones. However, Fujikawa et al., [7] failed to find out any association between age and final visual outcome might be due to the fact that they included higher aged group patients in their study (mean age >55.0 years) while the mean age of the patients of the present study, with or without irish prolapse were 37.53 and 35.63 years. In the current study, size of the injury was comparable. In iris prolapse group, majority 53.3% of the patient's injuries size were >10 mm and in the without iris prolapse group majority 43.3% of the injuries size were 1-5 mm. Patients with an injury that was smaller length had a statistically significant better visual prognosis than patients with an injury that were larger length (p=0.002). Patient with an injury that was smaller length had a statistically significant better visual prognosis than patients with an injury that were larger length. The findings of the study are well agreement with the findings of the other research works. [7,13,17] According to Rofail et al.,[18] an injury greater than 10 mm increased the likelihood of having a final visual acuity worse by 14.49 times when compared to lacerations 1 to 5 mm. Han and Yu [19] established that a larger injury (>10mm) was associated with poorer final visual acuity. These data revealed that the extent of the injury had both therapeutic and prognostic ramifications, with an increase in length being strongly associated with a worse visual outcome. The present study observed that most of the patient came within 24 hours of injury in both group. Our findings also show that the zone of injury was related to the visual outcome. In the study Puodžiuvienė et al.,[20] established that wound involving zone 3 had significantly poorer presenting and final visual acuity versus those involving zone 1 or 2. In this study majority of patients where in peripheral zone in both iris and without iris prolapse group. As this study considered only zone 1 injury, better visual outcome has been seen in peripheral involvement than the central injury. Singh et al [21] Ather et al.,[3] supports our with iris prolapse at 3 month follow up. Our outcomes are similar to previous studies of penetrating eye injuries. [7,20,22,23] There is a statistically significant difference between 3 months after surgery in visual acuity (P= 0.001). This study found lower level of LogMAR chart in without iris prolapse group than with Irish prolapse group which was 0.57±0.20 versus 1.57±0.90 respectively. The difference was statistically significant between with and without Irish prolapse group (P<0.001). Therefore, the findings. The present study found that initially 3.3% of patient present with 6/6 to 6/18 vision in without iris prolapse group but rest of the patients present with 6/24 to PL/PR vision in both group. This finding implies that a higher initial VA reflects lesser ocular tissue damage, resulting in a better visual prognosis. It is consistant with Han and Yu.[19] Other studies also reported similar findings. [7,16] During follow up period of 3 month, in without iris prolapse group 40.7% patients presented with 6/6-6/18 vision but in iris prolapse group 7.2% patients presented with the same vision. On the other hand, 26% and 16% patients presented with >6/18- PL/PR vision in with or without iris prolapse group. Analysis revealed that statistically significant (P<0.001) better outcome of visual acuity (LogMAR) without iris prolapse than findings of the study are in well agreement with the findings of the other research works Chang et al. [13] During follow up of 3 months, 35.8% patients had complication in iris prolapse group and 11.1% patients had complication in without iris prolapse group included traumatic cataract (25%), retinal detachment (17.9%), Endopthalmitis (3.6%) and some other (7.1%) in iris prolapse group, on the otherhand traumatic cataract (11.1%), retinal detachment (3.7%) in without iris prolapse group. Traumatic cataract was the most common complication in both group. It is the most frequent vision impairing complication which can occur at any time from day one to several years after injury. [24] This study's rate of post traumatic endopthalmitis (3.6%) was comparable to that seen in number of earlier investigations.[16] The rate is higher than those found in some reports from Asian nations; variations may be due to environmental variables that cause higher contamination in this population. [7,19] A study by Yuksel et al.,[25] found the endopthalmitis rate as 6.7% which is higher than this study. This emphasizes the fact that prevention of ocular injury should be prioritized as prevention is cheaper and better than treatment. Blindness prevention campaign should therefore be incorporated into the primary eye care to minimize ocular morbidity in eye injury. A well structured or planned eye health education workshop should be carried out at the local government area to teach the other health workers on eye health promotion so that the message will be widely disseminated to the rural dwellers. Furthermore, prompt recognition and ophthalmologic interventions are essential to maximizing functional outcome.

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CONCLUSION

Penetrating corneal injury without iris prolapse had better visual outcome after surgery than penetrating corneal injury with iris prolapse. Moreover, young patients with short duration, smaller size of injury and better visual acuity at presentation had better visual outcome than others.

Limitations

- Surgeries were done by multiple surgeons, so the quality of repair may interfere the result.
- Due to short period of time, long-term follow up could not be possible.

Recommendations

- We recommend a multicenter study with a large number of patients to confirm the above predictors for good visual outcome in cases of penetrating corneal injuries.
- Future research should focus on identifying factors that contribute to the differences in visual outcomes and developing strategies to improve postoperative BCVA in patients with Iris prolapse.

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