

How to Cite:

Bhattad, C. P., & Karambelkar, V. H. (2022). A prospective study to evaluate pediatric ocular trauma and its assessment with pediatric ocular trauma score at a tertiary carecentre in western Maharashtra. *International Journal of Health Sciences*, 6(S3), 4876–4889. <https://doi.org/10.53730/ijhs.v6nS3.6984>

A prospective study to evaluate pediatric ocular trauma and its assessment with pediatric ocular trauma score at a tertiary carecentre in western Maharashtra

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Abstract--- Vision” is a very much valuable gift given by the God. It is most cared for the function of a person and is possible only with healthy eyes. Eyeball is a well secured tissue in our body, but a minute trauma can cause such a damage that can lead to severe morbidity than any other organ. Eyes are protected by anatomical as well as physiological factors. The anatomical factors elastic fatty tissue and the bony orbit. Head turning reflex, blink reflex and lacrimation which following intrusion of any irritant material are the physiological factors. Ocular Injury represents a major threat to vision in the house, work, school, playground and in sports. 4 As Krishna Hospital, Karad is located on National highway we come across many cases of vehicle accidents. Also the presence of a school and playing ground nearby has led to increase in number cases of sports related ocular injuries. Therefore, this study is done to assess the clinical profile of ocular injuries in paediatric age group presenting to us, to estimate the visual prognosis with the help of Paediatric Ocular Trauma Score and to assess visual prognosis following effective treatment. To evaluate pediatric ocular trauma and its assessment with pediatric ocular trauma score at a tertiary care centre in western Maharashtra. Single centre hospital based prospective study where participants included where pediatric patients with ocular trauma visiting and getting treated in Krishna Hospital, Karad were studied for 18 Months (November 2019 to May 2021). total 75 cases were studied. All cases of age 15 years or below of ocular trauma visiting and getting treated at Krishna hospital, Karad were included in the study while previous

history of ocular trauma or surgical intervention for the same, mentally retarded patients, cases with congenital anomalies and patients not willing to participate were excluded. Ethical Clearance: Was obtained from the institutional ethics committee before starting the study. A written informed consent was collected from all the participants. A detailed history was taken, general examination and ocular examination was done. Radiological investigations like X-Ray, CT scan, MRI (if required after ruling out metallic foreign body) and B scan were done if required. A total of 75 pediatric ocular trauma cases. Out of 75 cases; 48 were males (64%) and 27 were females (36%). Maximum number of patients were in the age group between 6-10 years (54.67%) followed by age group 11-15 years (37.33%). Maximum number of male patients were in age group 6-10 years with 25 cases. (52.08%) Out of 75 cases; 42.67% had trauma to the right eye, 45.33% had trauma to left eye and 12% had trauma to both eyes. Among 75 patients majority of the patients had injury during sports and play (37.33%) followed by firecracker injury (24%). Injuries due to road traffic accidents and domestic injuries were 22.67% and 16 % respectively. Among 75 patients majority of patients had fire cracker injury (24%) followed by injury by stone 18.67% and plastic pipe injury seen in 10.67% patients. Regarding damage to the segment of eye, we observed that out of 75 cases, 49 cases- 65.33% had damage in anterior segment, 18 cases - 24% had damage in posterior segment, and both segments were damaged in 8 cases - 10.67%. POTS Score of 72 had better predictive value for better vision after 6 month follow up, with a sensitivity of 71% and specificity of 79% and PPV of 68% and NPV of 75%. Simple safety procedures like wearing helmet with face guard in cricket, protective goggles while travelling, supervising children while playing, etc. should be advocated using mass media. Special attention should be given when children are playing with their pet animals. Documentation system by designing a structured and standardized format to be used when clerking, treating and following up of ocular trauma patients which will help in doing more research on the area which in turn are fundamental in planning its emergency care services. Loss of vision can affect a child's life entirely socially, emotionally, and psychologically. So the pediatric age group should be provided with effective eye protection and should develop safety cultures. Health education regarding importance of vision and eye protections should be given in schools and educational health centres and also in sports academies. This will help to decrease the magnitude of blindness in children. So to conclude, it's a teamwork of viz. parents, teachers and doctors who can take this as a mission to prevent and manage ocular trauma in pediatric age group.

Keywords---pediatric ocular trauma, ocular trauma score, tertiary care centre.

Introduction

Eyeball is a fairly well protected structure in our body, but if it gets injured the damage is may cause serious disabling than any other organ. Eyes are protected by anatomical as well as physiological factors. The anatomical factors elastic fatty tissue and the bony orbit. Head turning reflex, blink reflex and lacrimation which following intrusion of any irritant material are the physiological factors.^{1, 2} Despite these protective mechanisms, injuries to the eye are commonly found and most of them are the cause for an ophthalmic emergency. Mostly, it is the anterior segment which includes conjunctiva, cornea, angle of anterior chambers, iris and the lens which is affected by the impact of an injury. However the posterior segment may also be implicated.³ The consequences of injuries like these are more dreadful due to the delicacy of the ocular tissue which may lead to permanent blindness. Hence they assume unusual social and economic importance, involving a huge cost in human unhappiness and economic inefficiency.^{4, 5}

Ocular Injury represents a major threat to vision in the house, work, school, playground and in sports. As Krishna Hospital, Karad is located on National highway we come across many cases of vehicle accidents. Also the presence of a school and playing ground nearby has led to increase in number cases of sports related ocular injuries.⁶ Therefore, this study is done to assess the profile of Ocular injuries in pediatric age group presenting to us and to assess their visual outcome following primary management (Medical and/or Surgical Repair).^{7, 8} By assessing the etiological factors of ocular injuries, it would be possible to identify effective steps of reducing and preventing the incidence of ocular trauma.⁹ Most of the injuries in children can be prevented by parental supervision, awareness of child activities and use of proper protective measures. Penetrating Injuries to the uvea (iris, ciliary body, choroid) can lead to inflammation (uveitis) which excites inflammation of the uvea of uninjured eye (sympathetic ophthalmitis). Hence an injury to one eye can result in total blindness.^{10, 11}

Many factors have been stated about ocular injuries with a great support of literature. And with evolution of newer technologies and surgical methods the management of these injuries has been improved a lot in past few decades. Evolution of advanced vitreoretinal techniques, better and finer instruments have helped in improving the vision in injured eyes which was thought to be impossible.^{12, 13} This study is planned to evaluate the clinical profile and etiology of injuries of the eye and subsequent visual prognosis with the help of Pediatric ocular trauma score. All patients under 15 years of age with ocular injuries are included in this study. Patients not willing for examination, history of surgical intervention for ocular trauma, mentally retarded and with congenital anomalies are excluded from this study. An honest attempt is made to evaluate the visual outcome after six months following management.

Objectives

- To study ocular trauma of Pediatric population.
- To assess Pediatric ocular trauma quantitatively on the basis of Pediatric Ocular Trauma Score.

- To assess visual prognosis clinically.
- To co-relate assessment of visual prognosis with Pediatric Ocular Trauma Score.

Methodology

Single centre hospital based prospective study where participants included where pediatric patients with ocular trauma visiting and getting treated in Krishna Hospital, Karad were studied for 18 Months (November 2019 to May 2021).

Sample size

Taking P value as 25%

According to a study “Pediatric ocular trauma”

$$\text{Sample Size } [n] = \frac{4pq}{L^2}$$

P = 25%,

L (Allowable error) = 10%

Q = 100-p = 75%

N (Sample size) = 75

All cases of age 15 years or below of ocular trauma visiting and getting treated at Krishna hospital, Karad were included in the study while previous history of ocular trauma or surgical intervention for the same, mentally retarded patients, cases with congenital anomalies and patients not willing to participate were excluded.

Ethical clearance

- Was obtained from the institutional ethics committee before starting the study.
- A written informed consent was collected from all the participants.
- A detailed history was taken, general examination and ocular examination was done. Radiological investigations like X Ray, CT scan, MRI (if required after ruling out metallic foreign body) and B scan were done if required.

Pediatric Ocular trauma score

This score is used to estimate visual prognosis following ocular trauma. Ocular injuries are categorized into three anatomical zones^{4,10}. Zone I includes the cornea and limbus, zone II is 5-mm posterior to the limbus, and Zone III, which includes the macula and optic nerve, is posterior to zone II. Patients with Zone 2 can have involvement of Zone 1 and patients with Zone 3 can have involvement of both Zone 1 and Zone 2. The raw points of higher zones are already reduced assuming involvement of lower zones, raw points of the highest zone involved are to be considered for calculating Pediatric Ocular Trauma Score. Patient variables, such as age, wound location and time lapse (i.e time interval between time of injury and patient visiting to the Ophthalmologist), were considered important parameters and were included in the scoring.

Table 1
Calculating the POTS:¹⁴

Variables	Raw points
Initial visual acuity	
NLP	10
LP/HM	20
Counting fingers	30
0.1–0.5	40
0.6–1.0	50
Age of the pediatric patients (years)	
0–5	10
6–10	15
11–15	25
Wound location	
Zone I	25
Zone II	15
Zone III	10
Concomitant eye pathologies	
Iris prolapse	–5
Hyphaema	–5
Organic/unclean injury	–5
Time lapse (>48 h)	–5
Traumatic cataract	–10
Vitreous haemorrhage	–20
Retinal detachment	–20
Endophthalmitis	–30

The following equation was to determine the trauma score in patients for whom an initial visual acuity was not obtained: $2 \times (\text{age} + \text{zone}) - \text{corresponding pathologies}$. The patients were divided into five groups (higher points is presumed to be better prognosis) based on the trauma evaluation score:

- Group 1: <45 points.
- Group 2: 46–64 points.

- Group 3: 65–79 points.
- Group 4: 80–89 points.
- Group 5: 90–100 points.

Baseline treatment, medical and surgical management of the patients was done according to individual case requirements.

Statistical analysis

Data was collected using a semi structured pretested questionnaire, data Collected was entered in Microsoft Excel 2013. Data is represented in frequencies and percentages, charts and graphs. Appropriate statistical tests are applied using SPSS software version 21 for analysis. Chi square test is used for association and ROC analysis is used for evaluation of POTS scoring technique to predict better patient outcome in the form of vision taken at 6 months follow up. Statistical significance is considered at $p < 0.05$.

Observations and Results

We studied a total of 75 pediatric ocular trauma cases. Out of 75 cases; 48 were males (64%) and 27 were females (36%). Maximum number of patients were in the age group between 6-10 years (54.67%) followed by age group 11-15 years (37.33%). Maximum number of male patients were in age group 6-10 years with 25 cases. (52.08%) Out of 75 cases; 42.67% had trauma to the right eye, 45.33% had trauma to left eye and 12% had trauma to both eyes. Among 75 patients majority of the patients had injury during sports and play (37.33%) followed by firecracker injury (24%). Injuries due to road traffic accidents and domestic injuries were 22.67% and 16 % respectively. [Fig 1]

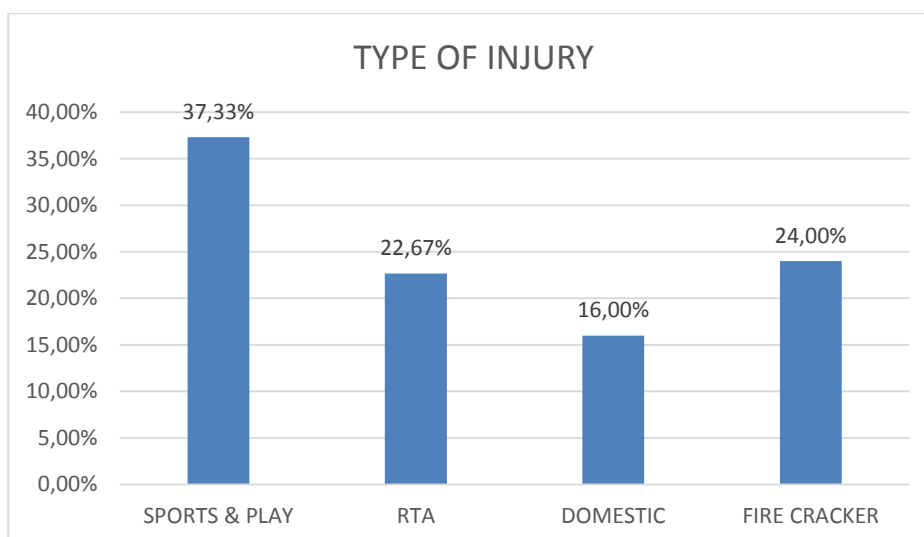


Fig 1. Distribution according to type of injury to eye

Table 2
Distribution according to etiology of trauma to eye

AETIOLOGY/ OBJECTS	NUMBER OF PATIENTS	PERCENTAGE
WOODEN	2	2.67%
PLASTIC BALL	8	10.67%
PLASTIC PIPE	2	2.67%
STONE	14	18.67%
VEGETATIVE MATTER	2	2.67%
ACCIDENT OR FALL	7	9.33%
FIST	1	1.33%
BAT	5	6.67%
BOW & ARROW	6	8.00%
RAQUET	2	2.67%
FIRE-CRACKER	18	24.00%
CHEMICAL	4	5.33%
CATS PAW NAIL	2	2.67%
DOG NAIL	1	1.33%
PARENTS NAIL	1	1.33%
TOTAL	75	100.00%

Among 75 patients majority of patients had fire cracker injury (24%) followed by injury by stone 18.67% and plastic pipe injury seen in 10.67% patients. Regarding damage to the segment of eye, we observed that out of 75 cases, 49 cases- 65.33% had damage in anterior segment, 18 cases - 24% had damage in posterior segment, and both segments were damaged in 8 cases - 10.67%. Anterior segment injuries were seen in 49 cases, out of which majority of the patient had conjunctival tear (22.67%) followed by corneal abrasions and Hyphema in 17.33% patients and 16% patients respectively. Corneal tears and iris involvement in 10.67% each was seen. 9.33% cases had lens involvement and 2.67% had RAPD. None of the patents in our study had Endophthalmitis. Posterior segment injuries were seen in 18 cases, maximum number of the patients had berlins oedema (16%) followed by retinal hemorrhage in 9.33% patients and vitreous hemorrhage in 8% patients. Retinal detachment, traumatic optic neuropathy, choroidal tear were each seen in 2.67% patients.

Out of total 75 cases; 61 - 81.33% had mechanical injury and 14 - 18.67% had chemical injury. Out of 61 mechanical injuries, majority of the patients had closed globe injuries that is contusion (63.93%) followed by open globe penetrating injuries seen in 16.39% patients. Laceration was seen in 8 patients (13.11%) and perforating injuries only in 4 patients (6.56%). Out of 8 cases with Iris involvement, 3 patients had iris sphincter damage (37.50%) followed by iridocyclitis and iris prolapse in 2 (25%) patients each. Iridolysis was seen in 1 case (12.50%). Out of 7 cases with lens involvement; maximum of cases had traumatic cataract 3 (42.86%) followed by subluxation 2 (28.57%), dislocation and vossius ring both were seen in 1 case - 14.29%

Table 3
Distribution according to Zone involvement among patients in view of trauma score

ZONE INVOLVEMENT (Highest Zone Involved)	NUMBER OF PATIENTS	PERCENTAGE
ZONE 1	27	36.00%
ZONE 2	21	28.00%
ZONE 3	27	36.00%
TOTAL	75	100%

Raw point's distribution

Zone 1 = 25

Zone 2 = 15

Zone 3 = 10

Patients with Zone 2 can have involvement of Zone 1 and patients with Zone 3 can have involvement of both Zone 1 and Zone 2. The raw points of higher zones are already reduced assuming involvement of lower zones, raw points of the highest zone involved are to be considered for calculating Pediatric Ocular Trauma Score. Out of 75 patients, 63 - 84% patients presented to the ophthalmologist within 48 hours of trauma and only 12 - 16% patients presented later than 48 hours. Out of all 75 patients, 24 were managed medically (32%) and 51 required both medical and surgical management (68%). Majority of the injuries were organic or unclear seen in 41 cases (54.67%).

Table 4
Relation of age and vision at time of injury to eye

VISION AT THE TIME OF INJURY						
AGE IN Yr	NO PL	PL TO HM	CF TO 6 M	6/60 TO 6/18	> 6/12	TOTAL
0-5	0	1	1	2	2	6
6-10	1	9	14	8	9	41
11-15	1	2	12	7	6	28
TOTAL	2	10	26	20	16	75

Out 6 patients of age group between 0-5 years, 2 patients presented with initial visual acuity of both more than 6/12 and between 6/60 – 6/12. In age group of 6 -10 years, 9 out of 41 patients had initial visual acuity of more than 6/12 and 1 patient with no light perception. In age group of 11 – 15 years 6 patients had initial visual acuity of more than 6/12 and 1 patient with no light perception.

Table 5
Relation of age and vision after 6 months of injury to eye

VISION AFTER 6 MONTHS OF INJURY						
AGE IN Yr	NO PL	PL TO HM	CF TO 6 M	6/60 TO 6/18	> 6/12	TOTAL
0-5	0	0	1	1	4	6

6-10	1	3	8	7	22	41
11-15	1	1	7	11	8	28
TOTAL	2	4	16	19	34	75

$P < 0.05$, Significant improvement was seen at the end of 6 months after follow up in patients.

- Out 6 patients of age group between 0-5 years, 4 patients had visual acuity of more than 6/12 .
- In age group of 6 -10 years, out of 41 patients, 22 patients had visual acuity of more than 6/12 , 7 patients had visual acuity of 6/60 to 6/18 and 8 patients with visual acuity of counting fingers.

In age group of 11 – 15 years 8 patients had visual acuity of more than 6/12, 11 patients had visual acuity of 6/60 to 6/18 and 7 patients with visual acuity of counting fingers.

Table 6
Comparison of probability of follow-up visual acuity category after 6 months in present study

RAW SCORE	POTS SCORE Group	NLP	PL TO HM	CF 6 TO 6 M	6/60 TO 6/18	>6/12	TOTAL NO. OF PATIENTS	PERCENTAGE OF PATIENTS WITH VA >6/12
0-45	1	2	3	7	4	1	17	5.88%
46-64	2	0	1	6	9	3	19	15.78%
65-79	3	0	0	1	5	11	17	64.70%
80-89	4	0	0	0	2	13	15	86.66%
90-100	5	0	0	0	1	6	7	85.71%
	Total	2	4	16	19	34		

$X^2 = 39.61$, $df = 16$, $p < 0.001$, Significant

POTS score was significantly associated with the follow up visual acuity at the end of six months. Higher points will show better prognosis and lower points will show poor prognosis.

- Group 1: 0 - 45 points only 5.88% of patients had visual acuity of more than 6/12.
- Group 2: 46 – 64 points only 15.78% of patients had visual acuity of more than 6/12.
- Group 3: 65–79 points 64.70% of patients had visual acuity of more than 6/12.
- Group 4: 80–89 points 86.66% of patients had visual acuity of more than 6/12.
- Group 5: 90–100 points. 85.71% of patients had visual acuity of more than 6/12.

This signifies that as the level of POT SCORE increases, the percentage of better vision also increases and it is statistically significant with P value < 0.01.

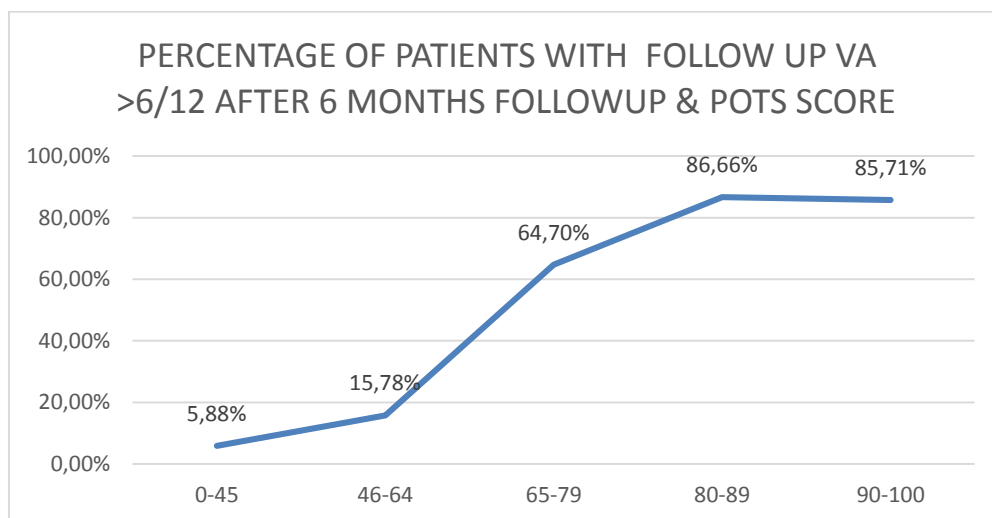


Fig 2. Percentage of patients with follow up va >6/12 after 6 months followup & pots score

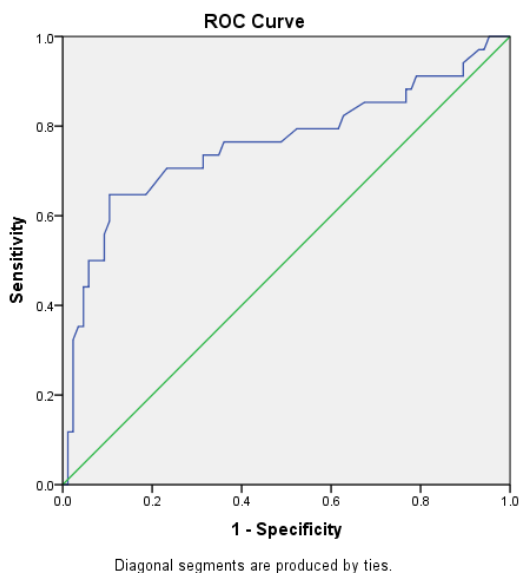


Fig 3. ROC analysis of POTS score to predict good vision of >6/12 after 6 month

AUC	95% Confidence Interval	Std. Error	P Value
0.76	0.65 – 0.87	0.056	< 0.001

Area under the curve was 0.76, there was significant positive correlation between the POTS Score and vision > 6/12 after 6 months. (p < 0.001) Higher the POTS score, there were more chances of better vision at follow up.

Table 7
ROC Curve- Analysis of POTS SCORE to predict better visual outcome after 6 months follow up

POTS score	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
58	79%	40%	37%	77%
72	71%	79%	68%	75%
84	65%	90%	87%	63%

POTS Score of 72 had better predictive value for better vision after 6 month follow up, with a sensitivity of 71% and specificity of 79% and PPV of 68% and NPV of 75%.

Discussion

In the study the patients were distributed according to various age groups and sex and it showed that maximum number of patients were in the age group between 6-10 years (54.67%) followed by age group 11-15 years (37.33%). Maximum number of male patients were in age group 6-10 years with 25 cases. (52.08%). Mean age of patients in our study is 9.31 ± 3.01 years. Similar findings was found in study done by Vishal Katiyar et al.¹⁵ on ocular trauma in Indian pediatric population in which male children between the age of 6 and 10 years constituted the largest group accounting for 41.1% (80/191) of total patients. In a study done by Rohit Saxena et al.¹⁶ majority of injuries occurred in children of 5 years and older (87.7%).

In our study, amongst 75 patients, maximum number of patients had injury during sports and play (37.33%) followed by firecracker injury which was seen in 23% of patients. Injuries due to road traffic accidents and domestic injuries were seen in 22.67% and 16% respectively. In a study done by Vishal Katiyar et al.¹⁵ where majority of children 83/191 (43.5%) sustained injuries at agriculture fields and work places adjoining their residence, out of which 83.5% were males and 49% were in age group of 6-10 years. This was followed by injuries sustained in domestic environments and accounted for 21.5% (41/191) cases. Ocular injuries associated with road traffic accidents accounted for 8.4% (16/191) of patients presenting in emergency with majority (75%) related to two wheelers. Fire cracker injuries accounted for about 7.3% (14/191) of injuries, mostly during Diwali season (October or November). In the study done by Ashok Madan et al.¹⁷ where sports-related injury like cricket ball, spinning top etc was common (29.5%) followed by those caused by wooden stick (22.9%) and firecrackers (18%).

75 patients were distributed of patients according to ocular damage to eye, anterior segment showed damage in 65.33%, posterior segment damaged in 24% and both segments were damaged in 10.67% of patients. It was seen that maximum number of patients had conjunctival tear (22.67%) followed by corneal abrasion (17.33%). Hyphema was seen in 17.33%. None of the patients in our study had endophthalmitis. In a study done by Ashok Madan et al.¹⁷ a perforating open globe injury to the cornea (n = 29, 47.5%) was the most common injury. In a closed globe injury, corneal abrasion (n = 7, 11.5%) was the most common injury followed by hyphema (n = 04, 6.6%). Other types of closed globe injuries were lid

and canalicular injuries (n = 03, 4.9%), chemical and orbital fractures (n = 01, 1.6%).

The relation between age and vision after 6 months of injury to eye was described. Significant improvement was seen at the end of 6 months after follow up in patients ($P < 0.05$). The relation between POTS and vision after 6 months was described. POTS score was significantly associated with the follow up visual acuity at the end of 6 months ($P < 0.05$). ROC analysis of POTS score in our study showed that the Area under the curve was 0.76, there was significant positive correlation between the POTS Score and vision $>6/12$ after 1 year. ($p < 0.001$) Higher the POTS score, there were more chances of better vision at follow up. We found that POTS Score of 72 and more had good predictive value for better vision after 1 year follow up, with a sensitivity of 71% and specificity of 79% and PPV of 68% and NPV of 75%.

M Shah et al¹⁸, in their study on Paediatric ocular trauma score as a prognostic tool evaluated the ROC analysis of POTS score and found that POTS predicted outcomes for the patients were more accurate as compared to that of the conventional OTS ($p = 0.014$). They concluded that the POTS is a more sensitive and specific scoring system with more accurate predictions as compared to the OTS, and it is a viable tool to predict the visual outcomes of pediatric ocular trauma, these findings are in accordance with our study findings. In a Study by Xue C et al¹⁹, the majority of the eyes sustained severe injuries with POTS of 1 (27.78%) and 2 (30%). Of the remaining patients, 20% had a POTS of 3, 16.67% had a POTS of 4, and 5.56% had a POTS of 5. These findings were in consistent with the findings of our study, where majority of the patients had scores in group 1 to 3.

Conclusion

The study was undertaken to assess pediatric ocular trauma clinically and estimate visual prognosis quantitatively with special reference of pediatric ocular trauma score. POTS, a very comprehensive score to estimate visual prognosis in pediatric patients with ocular injuries, so it should be used commonly in day to day practice by all the ophthalmologists. This study has shown the commonest causes of ocular injuries in pediatric age group is during sports and play followed by fire cracker injuries. Thus it is recommended preventive measures and proper supervision by parents or guardians while the children are playing should be taken. Simple safety procedures like wearing helmet with face guard in cricket, protective goggles while travelling, supervising children while playing, etc. should be advocated using mass media. Special attention should be given when children are playing with their pet animals. Documentation system by designing a structured and standardized format to be used when clerking, treating and following up of ocular trauma patients which will help in doing more researches on the area which in turn are fundamental in planning its emergency care services. Loss of vision can affect a child's life entirely socially, emotionally, and psychologically. So the pediatric age group should be provided with effective eye protection and should develop safety cultures. Health education regarding importance of vision and eye protections should be given in schools and educational health centres and also in sports academies. This will help to

decrease the magnitude of the blindness in children. So to conclude, it's a teamwork of viz. parents, teachers and doctors who can take this as a mission to prevent and manage ocular trauma in pediatric age group.

Conflict of interest: None

Source of Funding: This was a self-funded project

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