Epidemiology and visual outcome of pediatric ocular trauma in Mansoura ophthalmic center using pediatric ocular trauma score (POTS)

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Short title*:* Epidemiology and visual outcome of pediatric ocular trauma in MOC using POTS.

Abstract:

Purpose: to assess the epidemiology and the predicted visual outcome of pediatric ocular trauma using pediatric ocular trauma score (POTS) in MOC in the period from January 2016 to December 2020.

Methods: Records of patients below 18 years old attended to emergency department of Mansoura ophthalmic center suffering from ocular trauma in the period from January 2016 to December 2020 were reviewed. Demographic data were recorded. Type, mechanism, cause, place of injury and time between injury and attendance to emergency department were also recorded. Initial ophthalmic examination and surgical data were reviewed and POTS was calculated for each case.

Results: 559eyes of 559patients were included in this study, 72.8%were males and average age was 8 years. 428 children were from urban areas (76.6%). The most common visual acuities recorded were from HM to NPL (25%). There were (48.3%)open globe injuries, (25.9%) closed globe injuries and (25.7%) adnexal injuries. Of all cases with POT (7.8%)had ruptured globes, (9.12%) had lacerations, (34.7%)had penetrating injuries, IOFBs were found in (4.65%)of patients, contusions were in (16.8%)while perforation were in (1.07%). Zone I was the most affected zone (61.85%). Of all cases with open globe injuries, 92 had grade I (0-45)POTS(34%).

Conclusion: Ocular trauma in children is an important cause of visual loss in our locality rendering high percentage of poor outcome (25% VA less than HM). Children with open globe type of injuries, zone III injuries and posterior segment injuries had the poorest prognosis of vision (grade I POTS).

Key Words: Epidemiology, visual outcome, pediatric ocular trauma, MOC, POTS.

INTRODUCTION

Eye injuries remain a common and a preventable cause of blindness throughout the world. Despite public health efforts made to prevent eye injuries, eye injuries still occur. Identifying the causes and the nature of these injuries, and directing educational efforts towards minimizing eye injury, are the important goals of its prevention[1, 2].

Mechanical eye injuries are classified into closed-globe and open globe injuries. Closed globe injuries may be caused by blunt force leads to contusion, partial sharp force leads to lamellar laceration, and superficial foreign body. In open-globe injuries, the cornea or sclera may have a full thickness wound. This wound may be due to blunt trauma causing rupture or trauma by sharp objects leads to laceration. Sharp objects lead to penetrating injuries (single full thickness wound of the cornea or sclera), perforating injuries (entry and exit wounds of the cornea or sclera) or intraocular foreign body injury[3,4,5].

Injury leading to visual impairment may have an association with childhood development. Children are already vulnerable in their cognitive, motor, and social development, and their risk for delayed learning, limitations in skills acquisition, and impaired social relationships increases with visual impairment[6,7].

The consequences of childhood ocular injury are harmful as it leads to permanent blindness and visual handicap. It also represents a burden on the society. It also affects the psychological, social, and emotional development of a child[8,9].

Fortunately, pediatric ocular trauma (POT) is thought to be preventable in as many as 90% of the cases through improved recognition of risk factors for ocular injury and targeted intervention. In order to implement such targeted intervention, firstly it is necessary to understand ocular trauma etiologies within the pediatric population, so that preventative measures can be directed toward those children most at risk of injury[10].

The ocular trauma score (OTS) that has been developed by **Kuhn et al, (2002)[11]** has been widely used as a reliable prediction tool for the visual outcomes after an eye injury for adult. However, both the relative afferent pupillary defect (RAPD) and visual acuity (VA) are difficult to evaluate in certain cases in children. So, **Acar et al**,[12] proposed a new ocular trauma score system called pediatric penetrating ocular trauma score (POTS) to predict the visual outcome of penetrating eye injuries for children[13].

PATIENTS AND METHODS:

This study was a retrospective analytical study held in Mansoura ophthalmic center, Mansoura University, Egypt. Records of patients below 18 years old suffering from ocular trauma in the period from January 2016 to December 2020 were reviewed. Records with incomplete date were excluded from the study. A detailed history as the type of trauma, tool of injury, cause, place and time between injury and attendance to emergency department was obtained. Demographic profiles of all patients in terms of age, sex, residential area (urban or rural), date and time of injury, and any treatment were recorded.

A detailed ocular examination included visual acuity, slit lamp biomicroscopy, and fundus examination was done. In infants and preschool children visual acuity was evaluated using Teller Acuity Cards. In the rest of the children, visual acuity was assessed using a Landolt C chart. Intraocular pressure was measured, and ultrasound of the eye was done in all patients, except in those having open globe injuries. Radiography of the eye was done in all patients to exclude retained intraocular foreign body. Children who did not co-operate with the examination were examined under general anesthesia.

The site of ocular injury:

According to the site of penetration of the globe the outer coat of the

eye is classified into:

Zone I: Wounds occur limited to the cornea (corneoscleral limbus included)

Zone II: Wounds occur 5 mm posterior to the corneoscleral limbus.

Zone III: Wounds occur posterior to the anterior 5 mm of the sclera.

Pediatric Ocular Trauma Score was carried out according to the scoring system developed by **Acar et al (2011) [12]**.

- The score is calculated in each case by summation of the initial visual acuity, age and zone of injury corresponding points then subtracting the corresponding pathological disorders points (table 1).
- The following equation is used to determine the trauma score in patients in whom an initial VA was not obtained: 2 × (age + zone) - corresponding pathologies.

The final score is graded from the worst to the best prognosis: POTS-1 (0-45 points); POTS-2 (46-64 points); POTS-3 (65- 79 points); POTS-4 (80-89points); POTS-5 (90-100 points)[12].

Table 1: Pediatric ocular trauma score (POTS) [12].

Variables	Raw points
A: initial visual acuity	
NPL	10
LP/HM	20
CF	30
6/60 - 6/12	40
6/9 - 6/6	50
B: Age	
0-5	10
6-10	15
>10	25
C: Wound location	
Zone I	25
Zone II	15
Zone III	10
D: Concomitant eye pathology	
Iris prolapse	-5
Hyphema	-5
Organic /unclean injury	-5
Delay of surgery>48 h	-5
Traumatic cataract	-10
Vitreous hemorrhage	-20
Retinal detachment	-20
Endophthalmitis	-30

The ocular injuries were classified using the Birmingham Eye Trauma Terminology System (BETTS).

Surgical intervention regarding type of operation and time between injury and surgical management was recorded. **Statistical analysis:** Data were analyzed using Statistical Program for Social Science (SPSS) version 24. Quantitative data were expressed as mean ±SD. Qualitative data were expressed as frequency and percentage. **Mean (average):** the central value of a discrete set of numbers, specifically the sum of values divided by the number of values. **Standard deviation (SD):** is the measure of dispersion of a set of values. A low SD indicates that the values tend to be close to the mean of the set, while a high SD indicates that the values are spread out over a wider range.

Ethical consideration

- This study was approved by Mansoura medical research ethics committee, faculty of medicine, Mansoura University, No. (MS.21.06.1541) was taken; and was carried out in accordance with the Declaration of Helsinki of the world medical association.
- Informed consent was obtained from parents of each child before surgical interference by the concerned surgical team.

RESULTS

559 eyes of 559 patients were included in this study. The age of highest frequency of POT was school age (6y – 12y) in 229 children (40.9%). The least frequency of cases was infants (1 month – 1 year) in 8 cases (1.4%). While no cases were recorded in neonatal period. The average age at the time of admission was 8.27 ± 4.34 years (table 2).

Table 2: Age distribution of children

Age	Number of	Percentage
Neonates (0-1)	0	0
Infants (1 month – 1	8	1.4
Toddler (1y – 3y)	63	11.2
Preschool age (3y –	131	23.4
School age (6y – 12y)	229	40.9
Adolescent (12y –	128	22.8
Total	559	100

Boys were more likely to suffer from ocular injury than girls in this study. From 559 children, 407 were boys (72.8%) and 152 were girls (27.2%) with male to female ratio 2.6:1. Urban areas recorded a higher incidence of POT than rural areas by percentage of 76.9% and 23.1% of children respectively. Regarding the place of injury, 36.3% of children's injuries were at home while the least common site was at work by 5.3 % (figure 1).

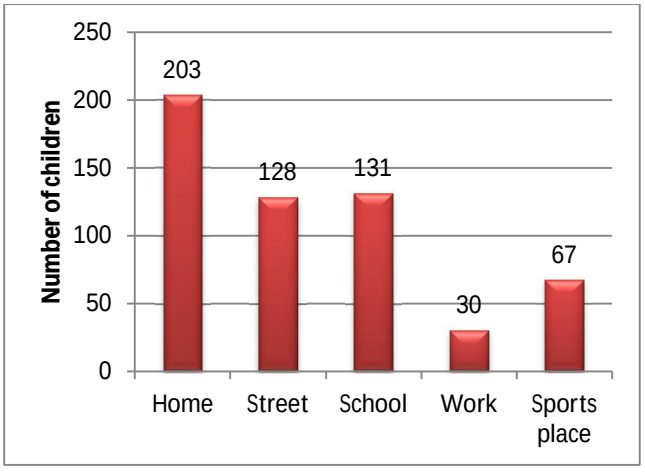

Fig.1: Distribution of children with eye injuries according to place of injury

There were (48.3%) open globe injuries, (25.9%) closed globe injuries and (25.7%) adnexal injuries. Among the children with POT, 44 cases had rupture globe (7.87%), 194 cases had penetrating ocular injury (34.7%), 26 cases had IOFB (4.65%), 94 cases had contusions (16.81%), 6 cases had perforating injuries (1.07) and 51 cases had Lamellar lacerations (9.12%) (table 3).

Table 3: Distribution of cases according to type of injury using (BETT)

Type of injury		Number of children	Percentage (%)
Open globe injury	Rupture	44	7.87
	Penetration	194	34.7
	IOFB	26	4.65
	Perforation	6	1.07
Closed globe	Contusion	94	16.81
	Lamellar	51	9.12

The majority of injuries included zone I (167 cases) with percentage of 61.9% followed by zone II (96 cases) 35.5% and finally zone III (7 cases) 2.6% (figure 2).

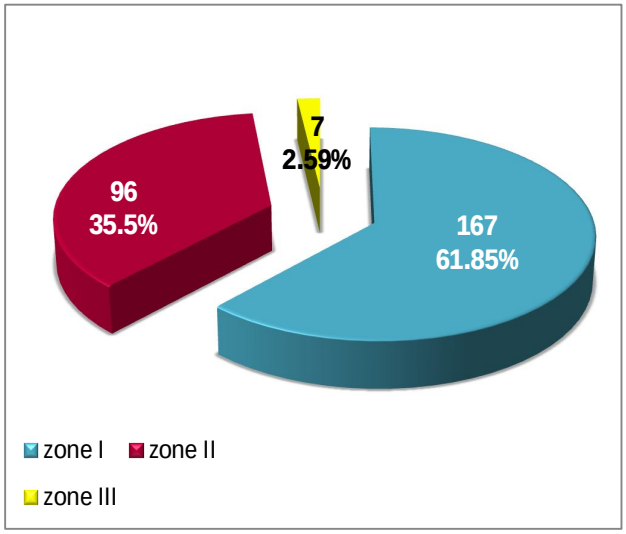

Fig. 2: distribution of zones of ocular injury

Among the children, visual acuity cannot be assessed at the time of presentation in 216 cases (38.6%) and the rest of children had visual acuity ranging from no perception of light (NPL) up to 6/6 (table 4).

Table 4: distribution of initial visual acuity in children

Vision	Number of	Percentage
cannot be	216	38.6
NPL	12	2.1
LP - HM	128	22.9
CF – 5/60	67	12
6/60 - 6/12	73	13
6/6 - 6/9	63	11.3
Total	559	100

Among this study, POTS were graded from 1 to 5 with poorest prognosis in grade 1 and best prognosis in grade 5. The grade with the highest frequency was grade 1 (34%) and least frequency was grade 5 (table 5).

Table 5: distribution of POTS grades

POTS grade	Number of	Percentage
Grade I (0-45	92	34
Grade II (46-64	88	32.6
Grade III (65- 79	77	28.5
Grade IV (80-89	9	3.3
Grade V (90-100	4	1.4

It was found that grade I POTS which had the poorest prognosis of visual outcome mostly influenced by the following factors: Poor initial VA (from HM to NPL) (49%), Posterior segment pathology (RD and vitreous hemorrhage with percentage of 100% and 77.7% respectively) and Injury in zone III (71.4%).

Time of attendance at the hospital: The time between injury and attendance to hospital are classified into less than 48 hours (549 cases) and more than 48 hours (10 cases) (table 6).

Table 6: time of attendance to hospital

Time	Number of children	Percentage
<48 h	10	1.8%
>48 h	549	98.2%
total	559	100%

DISCUSSION

Pediatric ocular trauma is common and can profoundly affect the child's development as well as his adult life.

Worldwide, a quarter of a million children require hospitalization for a serious ocular injury every year[14].

This study aimed to assess the epidemiology and the predicted visual outcome of pediatric ocular trauma using pediatric penetrating ocular trauma score (POTS) in Mansoura Ophthalmic Center, Mansoura university, Egypt in the period from January 2016 to December 2020.

In this study, it was found that there is a mild increase in the frequency of children with POT in the school age over preschool age. Also, a US population-based study of pediatric ocular injury from 1997–2006 showed that the incidence of injuries rises among children over the age of 12[15]. This can be explained that in this age group, the child starts going to school and is often involved in many sports activities. And also, many children in older ages may be involved in handicrafts or other works which let them exposed to work injuries.

In this study, pediatric ocular trauma occurred more than twice as often in boys than in girls (2.6: 1). Qayum et al. (2018)[16] also found that male to female ratio was 2.9:1. This observation is presumably as males are allowed to go outdoors more and also undertake hard jobs with the high physical contact and aggressive nature of play among young boys and culture highly regards females who are quiet and move gently.

Regarding the place of injuries, (36.3%) of injuries occurred at home, (23.4%) at school and (22.9%) at street. Rizal (2014)[17] also observed that most cases occurred at home (44.7%) followed by street (38.8%), school (6.8%) and work (4.9%) this reflects the lack of parental supervision at home.

Open globe injuries represented (48.3%) and those with closed globe injuries represented (25.9 %) and (25.7%) children had adnexal injuries of total children. Liu et al (2010)[18] also observed that open globe injuries (71.2%), adnexal injuries only (18.6%), or closed globe injuries (10.3%).

The majority of cases with POT were penetrating injuries (35.8%) followed by contusions (16.9%) while lamellar laceration, rupture globe and IOFB represented (9.1%), (7.9%) and (4.6%) respectively. Malek et al. (2020)[19] also found that penetrating trauma accounted for 68.3% of cases, followed by rupture (27.5%) and intraocular foreign body (IOFB) (7.5%) in patients with OGIs. [16] The predominance of open globe injuries over closed globe injuries in this study and many other studies may be attributed to negligence of seeking hospital care in our community in traumas that don't cause open globe injuries. However other studies stated that closed globe injuries is more common than open globe and this may be attributed to increase awareness in people whom study involved.

In this study, visual acuity could not be assessed especially in younger age (38.6%), the most common visual acuity recorded was from HM to NPL (25%). mainly HM (18.6%) of total children while the least visual acuity recorded was from 6/6 to 6/12 (14.1%). this can be explained that the majority of cases with visual acuity ranging from 6/6 to 6/24 are associated with adnexal injuries only including eyelids and conjunctiva which doesn't affect vision and the increase in the frequency of cases with low visual acuity reflect the dangerous effect of POT on vision.

Poor visual acuity ranging from HM to NO PL is associated mainly with open globe injuries (19.4%) of children with OGIs while closed globe injuries represented (5.3%) of cases with CGIs. This reflects the major serious effect of posterior segment injury (RD and vitreous hemorrhage) on vision.

The highest frequency of POTS grades was Grade I (0-45 points) by 34% and Grade II (46-64 points) by 32.6% respectively with least frequency for Grade V (90-100 points) by 1.4%. Xue et al. (2020) [13] observed that the majority of the eyes sustained severe injuries with POTS I (27.78%) and II (30%). Of the remaining patients, 20% had a POTS II, 16.67% had a POTS IV, and 5.56% had a POTS V.

In our study we found that there was a significant correlation between the POTS and the underlying pathology of the eye at time of injury. Grade I POTS which indicates the poorest prognosis of visual outcome included (100 %) of cases with RD and (77.7 %) of cases with vitreous hemorrhage, and about (70.4%) of cases with trauma in zone III. This reflected the more serious effect of posterior

segment injury on POTS and subsequently the visual outcome. Fujikawa et al.(2018)[20] also found that the most important predictors of poor visual outcome were open globe type of injury particularly if rupture globe especially if zone III is involved and if associated with RD or vitreous hemorrhage.

Conclusions

Ocular trauma in children is an important cause of visual loss rendering high percentage of poor outcome (25% VA less than HM) and Grade I POTS (0-45 points) represented by 34%. Boys were more vulnerable to POT than girls especially in school age. Children with open globe type of injuries, zone III injuries and posterior segment injuries (retinal detachment and vitreous hemorrhage) had the poorest prognosis of vision (grade I POTS).

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Data Availability: The authors declare that all data supporting the findings of this study are available within the article and its supplementary information file.

Competing interests: The authors declare no competing interests.

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Ethics declarations: All procedures performed in the study followed the 1964 Helsinki declaration and its later amendments, University Ethics Committee approved the project.

Conflict of interest

Dina Abdel Fattah, Mohamad H. Abdel Rahman, Yousef M. Elhelw, Abdel Moneim A. elhessy. All authors have no conflicts of interest that are directly relevant to the content of this review.

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REFERENCES

1. Stapleton, K.I., An Audit of X Academy's Shop Eye Protection Program. University of Wisconsin—Stout 2017.
2. Hoskin AK, Mackey DA, Keay L, Agrawal R, Watson S. Eye Injuries across history and the evolution of eye protection. Acta Ophthalmol. 2019;97(6):637-643.
3. Kaur A, Agrawal A. Paediatric ocular trauma. *Current Science*, 2005;*89*(1):43–46.
4. Shah SM, Shah MA, Singh R, Rathod C, Khanna R. A prospective cohort study on the epidemiology of ocular trauma associated with closed-globe injuries in pediatric age group. Indian J Ophthalmol. 2020;68(3):500-503.
5. Pelletier J, Koyfman A, Long B. High risk and low prevalence diseases: Open globe injury. Am J Emerg Med. 2023;64:113-120.
6. Ozkubat U, Ozdemir S. A comparison of social skills in Turkish children with visual impairments, children with intellectual impairments and typically developing children. Inter. J. of Inclusive Edu. 2014;18(5):500-514.
7. Pehere N, Chougule P, Dutton GN. Cerebral visual impairment in children: Causes and associated ophthalmological problems. Indian J Ophthalmol. 2018;66(6):812-815.
8. Barry RJ, Sii F, Bruynseels A, Abbott J, Blanch RJ, MacEwen CJ, Shah P. The UK Paediatric Ocular Trauma Study 3 (POTS3): clinical features and initial management of injuries. Clin Ophthalmol. 2019;13:1165-1172.
9. Madan AH, Joshi RS, Wadekar PD. Ocular Trauma in Pediatric Age Group at a Tertiary Eye Care Center in Central Maharashtra, India. Clin Ophthalmol. 2020;14:1003-1009.
10. Goodyear-Brown, P., Trauma and play therapy: Helping children heal. Routledge 2019;P.158.

11. Kuhn F, Maisiak R, Mann L, Mester V, Morris R, Witherspoon CD. The Ocular Trauma Score (OTS). Ophthalmol Clin North Am. 2002;15(2):163-5, vi.
12. Acar U, Tok OY, Acar DE, Burcu A, Ornek F. A new ocular trauma score in pediatric penetrating eye injuries. Eye (Lond). 2011;25(3):370-4.
13. Xue C, Yang LC, Kong YC. Application of pediatric ocular trauma score in pediatric open globe injuries. Int J Ophthalmol. 2020;13(7):1097-1101.
14. Nora AA, Nawal MS, Hedya FM, Taiseer HA. Knowledge and Practices of Mothers regarding their Children with Eye Trauma. Journal of Nursing Science Benha University, 2023;4(2):525-537.
15. Abbott J, Shah P. The epidemiology and etiology of pediatric ocular trauma. Surv. of ophthalmol. 2013;58(5):476-485.
16. Qayum S, Anjum R, Rather S. Epidemiological profile of pediatric ocular trauma in a tertiary hospital of northern India. Chinese journal of traumatology, 2018;21(02):100-103.
17. Rizal SOJ. Epidemiology and visual outcomes of pediatric ocular trauma cases in a tertiary hospital. Philipp J Ophthalmol, 2014;39:27-32.
18. Liu ML, Chang YS, Tseng SH, Cheng HC, Huang FC, Shih MH, Hsu SM, Kuo PH. Major pediatric ocular trauma in Taiwan. J Pediatr Ophthalmol Strabismus. 2010;47(2):88-95.
19. Malek I, Sayadi J, Zerei N, Mekni M, El Amri K, Zgolli H, Chebbi A, Nacef L. Epidemiology and prognostic factors of open globe injuries in a Tunisian pediatric population. J Fr Ophtalmol. 2020;43(7):604-610.
20. Fujikawa A, Mohamed YH, Kinoshita H, Matsumoto M, Uematsu M, Tsuiki E, Suzuma K, Kitaoka T. Visual outcomes and prognostic factors in open-globe injuries. BMC Ophthalmol. 2018;18(1):138.