Evaluation of Ocular Trauma Score in Open Globe Injuries

Umut Karaca[1], Gulsah Usta[1], Dilek Özkaya[1]

ABSTRACT

Purpose: To evaluate the epidemiological characteristics and ocular trauma scores (OTSs) of open globe injuries and to determine other factors that may affect OTS.

Materials and Methods: Patients who were diagnosed with open eye injuries, treated and followed up between July 2018 and July 2020 were retrospectively evaluated. The demographic features, injury type, initial and final visual acuity (Snellen chart), ophthalmoscopic examinations, hospitalization days and number of operations were recorded. OTSs were determined as described by Kuhn et al. in 2002.

Results: Forty-two patients, 12 of whom were female (28.6%), were included in the study. The mean age of the patients was 42.9 ± 19.4 (7-90). While the best corrected visual acuity of the patients at presentation was 0.038 ± 0.13 (Snellen line), it was evaluated as 0.37 ± 0.39 (Snellen line) at the final examination. When compared with the OTS study group, statistically significant differences were found in final VA. A statistically significant difference was found in the light perception (LP) (-) and 1/200-19/200 VA subgroups in Category 1 ($p < 0.001$). In Category 2 only the final VA between 1/200-19/200 was insignificant. In Category 3 the final VA of 68% patients was 20/40, or better; and 16% of the patients was between 20/200-20/40. Also, none of our patients had LP or hand motion (0%) at the end. All three values in Category 3 were statistically significantly different, either. The OTS was lower in eyes with iris damage (such as those with iris sphincter rupture, iridodialysis or iris defect) and in eyes with vitreous loss.

Conclusion: OTS provides prognostic information after ocular trauma and is reliable and applicable in the management of open globe injuries. It is open for improvement by adding different parameters. Other factors, such as iris damage and vitreous loss, that may negatively affect final visual acuity have to be considered in the rearrangement of OTS.

Keywords: Open Globe Injuries, Ocular Trauma Score, Iris Damage, Vitreous Loss.

INTRODUCTION

Ocular trauma is one of the most important causes of low vision and blindness, especially in developing countries; it negatively affects an individual's health and social life due to the long treatment process and irreversible vision loss[1]. According to the US data, approximately 2.5 million new eye injuries—and as a result approximately 50,000 cases of blindness—are encountered each year[2]. The insufficiency of epidemiological studies in developing countries delays the reveal of etiological factors and planning for prevention programs, thus further increasing the frequency of cases.

The Birmingham Classification (Birmingham Eye Trauma Terminology-BETT) is a comprehensive system that describes and classifies any type of trauma involving the eyeball[3]. In this system, traumas are divided into two subgroups: closed and open globe injuries. While open globe injury describes situations in which the integrity of the eyeball is impaired, the integrity of the eyeball is preserved in a closed globe injury due to blunt trauma. In contrast, the Ocular Trauma Score (OTS) is a trauma scoring system defined by Kuhn et al. in 2002 and aims to predict the final vision level based on the patient's initial findings[4].

Ocular Trauma Score is a scoring system that tries to predict the patient's possible final visual acuity based on some criteria after trauma. While the method gives a predictive value according to the initial examination criteria, it has been evaluated in retrospective case series for patients with different type of open globe injuries such as fatal weapons or fireworks exposure[5, 6]. Our aim in this study is to evaluate the epidemiological characteristics of open

1- Assist. Prof., Suleyman Demirel University, Department of Ophthalmology, Isparta, Turkey

Received: 18.01.2021
Accepted: 09.04.2021
Ret-Vit 2021; 30:281-284
DOİ: 10.37845/ret.vit.2021.30.48

Correspondence Adress:
Umut Karaca
Suleyman Demirel University, Department of Ophthalmology, Isparta, Turkey
Phone: +90 532 580 9649
E-mail: drumutkaraca@gmail.com

globe injuries and ocular trauma scores and to determine the effect of other factors on OTS.

MATERIALS AND METHODS

The data of the patients who were diagnosed with open globe injuries, treated and followed-up between July 2018 and July 2020 were retrospectively evaluated. Approval was obtained for this study by the SDU Faculty of Medicine Clinical Research Ethics Committee (25.09.2020-20 / 282), and this study was conducted in accordance with the Helsinki Declaration 2008 principles.

The demographic data of the patients, as well as the injury type, cause of injury, initial and final visual acuity (VA) with Snellen chart, examination findings, hospitalization days and number of operations, were recorded. Ocular Trauma Scores of the patients were determined by calculating the sum of the scores given to six different parameters (initial VA, presence of rupture, presence of endophthalmitis, presence of perforating injury, presence of retinal detachment and presence of afferent pupil defect) at the first examination, as shown in Table 1. Similar to the OTS study group, VA was divided into five categories (1-5) in our study. Other factors that could affect OTS such as hospitalization time, number of surgeries, precense of iris damage, vitreous loss, high intraocular pressure, vitreous hemorrhage and hyphema were evaluated.

The SPSS 20.0 (IBM Corp. USA) statistical analysis program was used for statistical evaluation. Whether the values conformed to the normal distribution was determined by the Shapiro-Wilks test. A summary of data is shown as mean ± standard deviation (SD). Chi-square test was used for comparison of categorical distributions of final visual acuities and OTS scores between OTS study and our series. Mann-Whitney U test was performed for the comparison of final visual acuities between the patients with and without hyphema, iris damage, vitreous haemorrhage and vitreous loss. The relationship between different variables and the final VA was analyzed using Spearman's rho correlation analysis. p-value < 0.05 was considered statistically significant.

Table 1: *Ocular Trauma Score.*

Variables	*Raw Points*
1. Initial visual acuity	
No light perception	60
Light perception/hand motion	70
1/200-19/200	80
20/200-20/50	90
≥20/40	100
2. Rupture	-23
3. Endophthalmitis	-17
4. Perforating Injury	-14
5. Retinal Detachment	-11
6. Afferent Pupillary Defect	-10

RESULTS

The study was carried out as an epidemiological retrospective case review covering Isparta and the surrounding zone. Forty-two patients, 12 of whom were female (28.6%), were included in the study. The mean age of the patients was 42.9 ± 19.4 (7-90) years. The mean follow-up time was 15.5 ±4.6 (7-24) months. The patients' best corrected visual acuity (BCVA) at presentation was 0.038 ± 0.13 (Snellen line), while BCVA was 0.37 ± 0.39 (Snellen line) at the final examination. The mean hospitalization time was 7.45 ± 5.3 days, and the patients had an average of 1.86 ± 1.0 operations. According to their frequency, the factors causing the injuries were wood, metal parts (nails, iron, welding dust, etc.), glass and stone fragments, respectively. Rarely, blunt objects and rose thorns, as roses are widely planted in our city, were also factors of trauma. The demographic characteristics of the cases are summarized in Table 2.

In our study, the final VA in the OTS categories is summarized in Table 3 together with the OTS study group. When compared with the OTS study, statistically significant differences were found in final VA. A statistically significant difference was found in the light perception (LP) (-) and 1/200-19/200 VA subgroups in Category 1 ($p < 0.001$). In Category 2 only the final VA between 1/200-19/200 was insignificant. In Category 3 the final VA of 68% patients was 20/40, or better; and 16% of the patients was between 20/200-20/40. Also, none of our patients had LP or hand motion (0%) at the end. All three values in Category 3 were statistically significantly different, either ($p=0.002$).

Table 2: *Demographic and etiological charactersitics of the patients.*

Age (year)	42.9 ± 19.4 (7-90)
Sex (F/M)	12/30
Initial visual acuity(SL)	0.038 ± 0.13
Final visual acuity(SL)	0.37 ± 0.39
Hospitalization(days)	7.45 ± 5.3
Num. of Operation	1.86 ± 1.0
Etiology	
Wood	12 (%27,9)
Metal	12 (%27.9)
Glass	6 (%14.0)
Stone	6 (%14.0)
Blunt objects	3 (%7)
Rose thorn	3 (%7)

F: Female, **M:** Male, **SL:** Snellen Line.

Table 3: *Comparison of Final Visual Acuities and OTS Categorical Distributions Between OTS Study and Our Series.*

OTS Points &Category	*LP(-) A/A'(%)*	*LP(+)/HM A/A'(%)*	*1-200/19-200 A/A'(%)*	*20-200/20-50 A/A'(%)*	*≥20-40 A/A' (%)*
0-44 1	74/51*	15/14	7/33*	3/5	1/2
45-65 2	27/8*	26/8*	18/16	15/24*	15/44*
66-80 3	0/0	11/0*	15/16	31/16*	41/68*
81-91 4	0/0	2/0	3/0	22/25	73/75
92-100 5	0/0	0/0	0/0	5/0	94/100

A: OTS study results and A': our study results. **LP:** Light Perception, **HM:** Hand Motion, * Statistically significant ($p<0.05$)

An increase in the days of hospitalization showed a statistically significant negative correlation with final VA ($p=0.01$, $r= - 0.379$). Although the number of operations was similar to hospitalization time, the difference was not statistically significant. ($p=0.31$, $r= - 0.160$) Other factors accompanying trauma, such as presence of hyphema, iris damage, high intraocular pressure, vitreous haemorrhage and vitreous loss, which are thought to affect the OTS score, were also examined. Ocular Trauma Score was significantly lower in eyes with iris damage (such as iris sphincter rupture, iridodialysis or iris defect) and in eyes with vitreous loss ($p<0.001$).

DISCUSSION

When the results of our study were compared with the results of the OTS study, which aimed to predict final VA in the first application, better results were obtained especially in Categories 2 and 3. The hospitalization time and the number of operations performed showed a significant negative correlation with final VA. Other factors that appeared to have an effect on patient OTS were iris damage and vitreous loss at presentation.

Ocular Trauma Score has been investigated in many previous studies. Open globe injuries[7-10], closed globe injuries[11, 12] and intraocular foreign bodies[13, 14] were evaluated in terms of OTS, and the reliability of the system in different injury types was assessed. While Unver et al. emphasized in their study on 114 patients with open globe injuries that OTS is an appropriate predictive system, Serdarevic showed that OTS can be applied with high sensitivity in closed globe injuries[15, 16]. In another study, Guven reported that OTS can be used with 68% accuracy, especially in Categories 4 and 5, in injuries with intraocular foreign body.[14]Although OTS is a formularized estimation method that is still actively used, its prognostic value in predicting final visual acuity is controversial. It has been shown in the study conducted by Morgan et al., in which OTS and paediatric OTS were evaluated, there was an underestimation in final visual acuity in more than one category[17]. Similarly, Brundgridge et al. emphasized the difficulty of detecting retinal detachment in the initial examination, that diminishes the effective scoring after open globe injury[18]. Our study also showed similarities with the literature with results compatible with OTS, especially in the upper categories. Final visual acuities were found to be statistically higher than OTS, especially in Categories 2 and 3. This situation suggests that other factors may be effective in the calculation of OTS, especially in serious injuries.

Many studies have been done on the predictive power and accuracy rate of the OTS and other factors that may affect the OTS have been investigated[7, 19, 20]. A retrospective study conducted by Agrawal et al. in Singapore in 2020 evaluated the factors affecting OTS in open globe injuries; preoperative variables, such as injury type, preoperative VA, traumatic cataract, hyphema, relative afferent papillary defect, vitreous loss and vitreous haemorrhage, have shown to negatively affect the final visual outcome.[7] Factors likely to affect final VA after trauma, including age, mechanism or type of injury, delay time between injury and surgery, injury site, vitreous haemorrhage, lens damage, number of operations, hyphema, facial and adnexal injuries and presence and type of intraocular foreign body have been reported[19, 21, 22]. In our study, we also examined other factors that may affect the OTS, and as a result, we found that OTS was significantly lower in eyes with iris damage and vitreous loss. Iris damage and vitreous loss may indicate the possible damage of trauma on the posterior segment and can be considered a negative factor affecting final VA.

The low sample size and retrospective nature of our study are the main limitations. Furthermore, the fact that intraocular foreign bodies were not evaluated as an independent factor can be considered a limitation, since the presence of an intraocular foreign body may decrease final VA.

In conclusion, OTS provides prognostic information after ocular trauma and is reliable and applicable in the

management of eye trauma. Other factors, such as iris damage and vitreous loss, that may negatively affect final VA have to be considered in the rearrangement of OTS. Investigating all factors that may affect the ocular trauma score in larger, multi-centre and long-term studies and re-planning the scoring system will increase its reliability and accuracy.

Acknowledgments

Funding&Disclosures. All authors declare that they have no conflicts of interest and did not receive any support in the form of grants, drugs, etc.

Authorship. The authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Compliance with Ethics Guidelines. The procedures in this manuscript were conducted ethically in accordance with the tenets of the Declaration of Helsinki. Informed consent was obtained from all the participants. All subjects gave consent to publish this manuscript. No identifiable patient information is shown in this manuscript.

Data Availability. Data sharing is not applicable to this article, as no datasets were generated or analyzed during the current study.

REFERENCES

1. Oiticica-Barbosa MM, Kasahara N. Eye trauma in children and adolescents: Perspectives from a developing country and validation of the ocular trauma score. *J Trop Pediatr*. Aug 2015;61:238-43. doi:10.1093/tropej/fmv010
2. May DR, Kuhn FP, Morris RE, et al. The epidemiology of serious eye injuries from the United States Eye Injury Registry. *Graefes Arch Clin Exp Ophthalmol*. 2000;238:153-7. doi:10.1007/pl00007884
3. Kuhn F, Morris R, Witherspoon CD. Birmingham Eye Trauma Terminology (BETT): terminology and classification of mechanical eye injuries. *Ophthalmol Clin North Am*. 2002;15:139-43, v. doi:10.1016/s0896-1549(02)00004-4
4. Kuhn F, Maisiak R, Mann L, Mester V, Morris R, Witherspoon CD. The Ocular Trauma Score (OTS). *Ophthalmol Clin North Am*. 2002;15:163-5, vi. doi:10.1016/s0896-1549(02)00007-x
5. Qi Y, Zhu Y. Prognostic value of an ocular trauma score in ocular firecracker trauma. *J Burn Care Res*. 2013 May-Jun 2013;34(3):e183-6. doi:10.1097/BCR.0b013e3182676ce0
6. Unal MH, Aydin A, Sonmez M, Ayata A, Ersanli D. Validation of the ocular trauma score for intraocular foreign bodies in deadly weapon-related open-globe injuries. *Ophthalmic Surg Lasers Imaging*. 2008;39:121-4. doi:10.3928/15428877-20080301-15
7. Agrawal R, Wei HS, Teoh S. Prognostic factors for open globe injuries and correlation of ocular trauma score at a tertiary referral eye care centre in Singapore. *Indian J Ophthalmol*. 2013;61:502-6. doi:10.4103/0301-4738.119436
8. du Toit N, Mustak H, Cook C. Visual outcomes in patients with open globe injuries compared to predicted outcomes using the Ocular Trauma Scoring system. *Int J Ophthalmol*. 2015;8:1229-33. doi:10.3980/j.issn.2222-3959.2015.06.28
9. Malek I, Sayadi J, Zerei N, et al. Epidemiology and prognostic factors of open globe injuries in a Tunisian pediatric population. *J Fr Ophtalmol*. 2020;43:604-610. doi:10.1016/j.jfo.2019.10.024
10. Xue C, Yang LC, Kong YC. Application of pediatric ocular trauma score in pediatric open globe injuries. *Int J Ophthalmol*. 2020;13:1097-1101. doi:10.18240/ijo.2020.07.13
11. Duan F, Chen X, Zhang S, Qi X, Shi W, Gao H. Clinical Characteristics and Visual Outcomes of Patients Hospitalized for Ocular Trauma in Shandong Province, China. *J Ophthalmol*. 2020;2020:5826263. doi:10.1155/2020/5826263
12. Shah MA, Shah SM, Applewar A, Patel C, Shah S, Patel U. OcularTrauma Score: a useful predictor of visual outcome at six weeks in patients with traumatic cataract. *Ophthalmology*. 2012;119:1336-41. doi:10.1016/j.ophtha.2012.01.020
13. Justin GA, Baker KM, Brooks DI, Ryan DS, Weichel ED, Colyer MH. Intraocular Foreign Body Trauma in Operation Iraqi Freedom and Operation Enduring Freedom: 2001 to 2011. *Ophthalmology*. 2018;125:1675-1682. doi:10.1016/j.ophtha.2018.06.006
14. Guven S. Verification of Ocular Trauma Score for Intraocular Foreign Bodies in Lethal-Weapon-Related Ocular Injuries. *Mil Med*. 020;185:e1101-e1105. doi:10.1093/milmed/usaa042
15. Unver YB, Kapran Z, Acar N, Altan T. Ocular trauma score in open-globe injuries. *J Trauma*. 2009;66:1030-2. doi:10.1097/TA.0b013e3181883d83
16. Serdarevic R. The ocular trauma score as a method for the prognostic assessment of visual acuity in patients with close eye injuries. *Acta Inform Med*. 2015;23:81-5. doi:10.5455/aim.2015.23.81-85
17. Morgan AM, Kasahara N. Comparative Evaluation of the Prognostic Value Between the Ocular Trauma Score and the Pediatric Penetrating Ocular Trauma Score. *J Craniofac Surg*. 2018;29:1776-1779. doi:10.1097/SCS.0000000000004937
18. Brundridge W, Reed D, Santamaria J, Mehta A, Valentin F, Davies B. Open globe trauma in a military hospital: a review of the Ocular Trauma Score to help predict enucleation or evisceration. *Graefes Arch Clin Exp Ophthalmol*. 2019;257:1789-1793. doi:10.1007/s00417-019-04356-5
19. Islam QU, Ishaq M, Yaqub MA, Mehboob MA. Predictive Value Of Ocular Trauma Score In Open Globe Combat Eye Injuries. *J Ayub Med Coll Abbottabad*. 2016;28:484-488.
20. Meng Y, Yan H. Prognostic Factors for Open Globe Injuries and Correlation of Ocular Trauma Score in Tianjin, China. *J Ophthalmol*. 2015;2015:345764. doi:10.1155/2015/345764
21. Yu Wai Man C, Steel D. Visual outcome after open globe injury: a comparison of two prognostic models--the Ocular Trauma Score and the Classification and Regression Tree. *Eye (Lond)*. 2010;24:84-9. doi:10.1038/eye.2009.16
22. Pahor D, Gracner T. Comparison of the Ocular Trauma Score and Pediatric Ocular Trauma Score as Two Prognostic Models in Pediatric Open Globe Injuries. *Klin Monbl Augenheilkd*. 2020;doi:10.1055/a-1194-5104