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Eye injury and demographic parameters associated with poor visual outcome Lésion oculaire et paramètres démographiques associés à un faible résultat visuel

Nina Jovanovic[1,*], **Corinne Peek-Asa**[2], **Tracy Young**[2], **Faruk Nisic**[3], **Sanjin Musa**[4]

[1]Ophthalmology Department, Canton Hospital, Zenica

[2]Injury Prevention Research Center (IPRC), College of Public Health, The University of Iowa

[3]Eye Clinic, Clinical Center University of Sarajevo

[4]Institute for Public Health in Federation of Bosnia and Herzegovina, Sarajevo

Abstract

Background : Eye injuries can result in long-term disability, and healthcare providers need better tools to predict outcomes. Few prognostic models for poor visual acuity have been examined using variables usually present in very severe injuries, which creates a gap in prognosis. Therefore, a model associated with severe and less severe injuries is examined.

Methods : Eye injuries hospitalized in Bosnia and Herzegovina from 2006 through 2014 were included. A total of 298 eye injuries met the inclusion criteria of being an acute mechanical, chemical or physical eye injury. Prognostic variables were grouped by patient characteristics, eye injury characteristics and eye injury diagnosis. Poor final visual acuity was the main outcome measure (vision less than 20/200). Multivariate regression analysis used stepwise selection to identify the strongest set of predictive variables.

Results : Lens subluxation (95 % CI : 2.09–14.83), vitreous prolapse (95 % CI : 2.76–26.87), vitreous hemorrhage (95 % CI : 1.71–10.03), posterior segment intraocular foreign body (95 % CI : 1.19–39.09), and vitritis (95 % CI : 0.97–11.12) were significantly associated with poor final visual acuity. The predictive model identified the combination of age over 36, lens subluxation, vitreous prolapse and hemorrhage, vitritis, and macular hemorrhage as the combination most likely to have poor visual acuity. The final model resulted in a strong fit as measured by AIC, log likelihood, goodness-of-fit, and the c-statistic.

[*]**Corresponding author:** Nina Jovanovic, nina-jovanovic@uiowa.edu, Tél. : +387 61 276 422, Ophthalmology Department, Canton Hospital Zenica, Crkvice 67, 72000 Zenica, Bosnia and Herzegovina.

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Conflict of Interest :
The authors declare no conflict of interest or competing interests.

Conclusions : This model can be used in clinical practice to evaluate severity and predict final visual acuity in both severe and less severe eye injuries. The model accounts for characteristics of the injury as well as the patient. Additional studies with larger samples could further verify this model.

Résumé

Les lésions oculaires peuvent survenir après une invalidité à long terme et les fournisseurs de soins de santé ont besoin de meilleurs outils pour prédire les résultats. Peu de modèles pronostiques pour une faible acuité visuelle ont été examinés. en utilisant des variables généralement présentes dans les blessures très graves, ce qui crée un écart dans le pronostic. Par conséquent, un modèle associé à des blessures graves et moins graves est examiné.

Les blessures aux yeux hospitalisées à l'hôpital de Bosnie-Herzégovine de 2006 à 2014 ont été incluses. Au total, 298 lésions oculaires répondaient aux critères d'inclusion suivants : lésion oculaire mécanique, chimique ou physique aiguë. Les variables pronostiques ont été regroupées comme caractéristiques du patient, caractéristiques des lésions oculaires et diagnostic des lésions oculaires. La principale mesure de résultat (vision inférieure à 20/200) était la faible acuité visuelle finale. L'analyse de régression multivariée a utilisé une sélection par étapes pour identifier le plus puissant ensemble de variables prédictives.

subluxation du cristallin (IC 95 % : 2,09–14,83), prolapsus vitré (IC 95 % : 2,76–26,87), hémorragie vitrée (IC 95 % : 1,71–10,03), corps étranger intraoculaire dans le segment postérieur (IC 95 % : 1,19). −39,09) et la vitrite (IC 95 % : 0,97–11,12) étaient significativement associés à une faible acuité visuelle finale. Le modèle prédictif a identifié l'association comme étant l'âge le plus élevé de 36 ans, la subluxation de la lentille, le prolapsus et l'hémorragie vitreux, la vitrite et l'hémorragie maculaire comme la combinaison la plus susceptible d'avoir une faible acuité visuelle. Le modèle final a donné un fort ajustement, mesuré par AIC, log vraisemblance, qualité de l'ajustement et statistique c.

Ce modèle peut être utilisé en pratique clinique pour évaluer la gravité et prédire l'acuité visuelle finale des lésions oculaires graves et moins graves. Le modèle s'appuie sur les caractéristiques de la blessure et du patient. Des études supplémentaires avec des échantillons plus grands pourraient confirmer davantage ce modèle. Mots clés : traumatisme oculaire, score pronostique, résultat visuel, modèle pronostique

Keywords

eye trauma; prognostic score; visual outcome; prognostic model

Introduction

Ocular trauma impacts up to 55 million people in the world each year, of which 1.6 million develop blindness [1]. Based on reports from developing countries, eye trauma was the cause for 5 % of blindness, with trauma disproportionately causing of blindness in young people. Ocular trauma is also disproportionately prevalent in low and middle-income countries [2]. Many risk factors for ocular trauma have been documented, including occupational risks, explosives, working with machinery, and eye injuries associated with motor vehicle crashes

[3–5]. Eye injuries can produce substantial disability when vision loss occurs. Both patients and their healthcare providers benefit from knowledge about the anticipated visual impact from different types and diagnoses of ocular trauma.

Many studies validated the prognostic accuracy of the Ocular Trauma Score (OTS) in predicting visual outcome of injured eyes [6–13], and many studies have examined individual prognostic factors, such as poor visual acuity, vitreous prolapse or retinal detachment [14], age, and cause of injury [15] in predicting final visual acuity [14–19]. Accurate prognostic tools applied early in the process of care and treatment are helpful for decision making for the ophthalmologist and for informing the injured patient.

The most widely used tools, the OTS [20] and The Classification and Regression Tree (CART) prognostic model [11,21] predict visual acuity using several individual variables. The OTS uses visual acuity at presentation, retinal detachment, endophthalmitis, relative afferent pupillary defect, globe rupture and perforating globe injury to calculate a numerical visual acuity scale that ranges from 1 (no perception of light) to 5 (more than 20/40). CART uses a recursive partitioning decision tree statistical method, which predicts functional outcomes of open globe injuries using dichotomized input variables : relative afferent pupillary defect, initial vision, lid laceration, and posterior wound location. Several studies have validated OTS as an accurate prognostic tool, primarily for eye injuries leading to severe impairments [11]. The OTS is helpful because it incorporates many variables, especially since studies of individual variables have less consistent prognostic ability. For example, age has been found in some studies to have prognostic value [16,22] and in other studies not [23]. However, OTS is not always possible to calculate, especially for less severe eye injuries, because these patients do not present with rupture globe, relative afferent pupillary defect, perforating injury, or other injury characteristics included in the OTS or CART. However, patients with less severe injuries may also be at risk for visual impairment. Therefore, there is a need to create a new prognostic tool which could be used to predict poor visual outcome in injuries with a wide range of severity using various clinical and patient characteristics. The aim of this study is to create a predictive model which can be used by ophthalmologist at patient admission to predict final visual acuity for both severely and less severely eye injured patients.

Materials and methods

Location and subjects

The study was a clinical case series conducted at the Eye Department, Canton Hospital Zenica (CHZ), Bosnia and Herzegovina (B&H). Informed consent was obtained from all individual participants included in the study. The Ethical committee (IRB) of the CHZ approved this study prospectively, including data collection, analysis, interpretation and publication for research purpose. This facility is the largest healthcare facility in the Zenica-Doboj Canton and functions as a Level II Trauma hospital. It serves as the main trauma center for eye injuries throughout Central Bosnia.

Every patient over age four with a mechanical, chemical, or physical injury of the eye and its adnexa who was admitted for in-hospital treatment from January 1st 2006 through December

31st 2014 was included in the study. Medical charts, hospital protocols and discharge letters of all patients were reviewed retrospectively during 2015. A total of 258 patients were identified. If both eyes were injured, data from the more severely injured eye were included. Three eye injuries lacking final visual acuity data due to primary enucleation, evisceration, or optic nerve avulsion were excluded from the statistical analysis.

Procedure

Data were collected using an Initial Report Questionnaire, a modified bilingual version of the United States Eye Injury Register Initial Report. Incorrect and outdated classifications and terminology in medical records were reviewed by the lead author and adjusted according to the International Statistical Classification of Diseases, 10th Revision (ICD-10), Birmingham Eye Trauma Terminology System criteria (BETT) and Ocular Trauma Classification Group (OTCG) [24] for purpose of reporting elsewhere [5].

Study variables

We examined three categories of variables : patient characteristics, eye injury characteristics, and eye injury diagnoses. Patient characteristics were age, sex, occupation/employment status, time from injury to admission, and length of in-hospital stay. Age was categorized based on the distribution of the data as less than 36, 36 to 65, and above 65 years of age at the time of injury. Occupation and (or) employment status was difficult to categorized due to numerous different jobs descriptions. We therefore created six categories to focus on employment status, since occupational risks are associated with eye injury : retired seniors; students and homemakers without an official salary; manual labor workers; fire and electric force workers; agricultural workers, farmers and lumberjacks; and unemployed patients. Time from injury to admission was categorized as less than 24 hours, 1 to 2 days, 3 to 6 days and more than 7 days.

Eye injury characteristics were : injured lids, sclera, choroid, extraocular muscles, Initial Visual Acuity, Final Visual Acuity (obtained at the 6-month follow up), post-equatorial open injury, pre-equatorial open injury, uveal tissue in the wound, wound dehiscence, levels of hyphema, iridodialysis, relative afferent pupillary defect, intraocular pressure, traumatic cataract, lens subluxation, vitreous hemorrhage, vitreous prolapse, retinal hemorrhage, macular hemorrhage, retinal edema, macular edema, retinal tear, retinal detachment, optic nerve injury, orbital damage, uveitis, vitritis, endophthalmitis, injury zone, and Ocular Trauma Score. Initial and final visual acuity were categorized into five ordinal categories : no light sense and projection; only light sense and projection; 1/200–19/200; 20/200–20/50; ≤20/40. Levels of hyphema were categorized into three levels : 1/3rd, 2/3rd and total hyphema. Intraocular pressure was categorized based on the distribution of data as less than 11 mmHg, 12 to 20 mmHg, and more than 21 mmHg. Injury zone had three levels (1,2, and 3) and OTS had five ordinal categories 1; 2; 3; 4; 5. Other variables in this group were dichotomous categorical with Yes/No categories.

Eye injury diagnosis variables based on the Birmingham Eye Trauma Terminology System (BETT) classification were : closed globe injury, contusion, lamellar laceration, open globe injury, penetration of cornea, penetration of sclera, anterior segment intraocular foreign

body, posterior segment intraocular foreign body, rupture, perforating injury, and burn. All variables were categorical dichotomous with Yes/No categories.

Statistical Analysis

For the statistical analysis, we dichotomized initial and final visual acuity into two categories : first category : no light sense and projection/only light sense and projection/< 20/200; and second category : ≥20/200, following criteria of the United States Eye Injury Registry, a large study where legal blindness was defined as vision worse than 20/200 [8,25]. Final visual acuity (FVA) was assessed first at hospital discharge and at 6-month follow up. The latter was obtained as FVA. We identified crude odds ratios and 95 % confidence to examine significant variables associated with poor final visual acuity. For demographic variables, we performed Fisher's exact tests to test interdependence between two levels of FVA, at $\alpha = 0.05$. Fisher exact tests were used due to few cells counts for some variables.

Multivariate logistic regression analysis was used to find the best model for predicting poor visual acuity. Only covariates significant in the univariate analysis were included in the multivariate modeling. We yielded several models by running manual stepwise selection and statistical model selection. Variables that showed high collinearity (i.e., open globe and closed globe) with stronger predictors, or had small cell sizes (e.g. rupture, retinal tear/hole, retinal detachment, optic nerve damage, orbital damage, burn) were omitted. We tested several models using the variables (from the univariate analysis) : injured lids, iridodialysis, relative afferent pupillary defect (RAPD), uvea in wound, wound dehiscence, vitreous hemorrhage, vitreous prolapse, lens subluxation, vitritis, retinal hemorrhage, macular hemorrhage, injury zone, total hyphema. All models were controlled for age. Due to the small number of patients with poor visual acuity (n = 45), we limited our final model to the most clinically relevant and/or statistically significant covariates. Clinical relevancy was based on previously published results [18]. All analyses were first performed using RStudio Version 0.99.451 and additionally rechecked using SAS 9.4.

Results

We collected data from 258 patients who were admitted for ocular trauma. Three patients had primary enucleation procedures and visual acuity measures were not relevant and thus were excluded from this analysis. The resulting 255 patients, including 222 males (87.1 %) and 33 females (12.9 %), comprise the study sample. Mean age for injured patients was 36.8 years (Median : 36). Age categories showed significant differences when distributed along the levels of final visual acuity ($p = 0.004$, at alpha = 0.05), together with time from injury to admission ($p = 0.008$) and length of in-hospital stay ($p = 0.001$), while sex, and occupation were not significant ($p = .9$; $p = 0.52$; respectively) (Table 1).

Closed globe injury was present in 61.2 % of patients and 38.8 % of patients had open globe injuries. Contusion was diagnosed in 54.9 %, and among these many patients had additional diagnoses. For example, lamellar laceration was diagnosed in 29.4 % of patients with contusion. Initial visual acuity was poor in 40 % of patients and good in 60 %. Among injured tissue, 38 % had tissue injury to the lids and 20.8 % to the uvea. The least frequent injuries were extraocular muscle damage, choroid damage, and macular hemorrhage, found

in 3.9 %, 5.1 % and 4.7 % of cases, respectively. Injury was localized most often in zone 1 (38.1 %), less often in zone 2 (34.5 %), and least often in zone 3 (27.1 %) (Table 2).

Fisher's exact test for independence was used to identify univariate statistical significance. Significant clinical variables (alpha = 0.05) were : injured lids, injured sclera, injured choroid, injured extra-ocular muscles, low initial visual acuity, closed globe injury, contusion, lamellar laceration, open globe injury, rupture, uvea in wound, wound dehiscence, total hyphema, iridodialysis, traumatic cataract, lens subluxation, vitreous hemorrhage, vitreous prolapse, retinal detachment, retinal hemorrhage, macular hemorrhage, vitritis, relative afferent pupillary defect, injury zone, and Ocular Trauma Score (Table 2).

Clinical variables associated with poor final visual acuity (FVA), controlled for age and sex and sequenced from the highest adjusted OR were : injury zone 3 (AdjOR = 16.45; CI : 5.33–50.76), vitreous prolapse (AdjOR = 14.07; CI : 5.42–36.51), iridodialysis (AdjOR = 13.51; CI : 5.83–31.31), lens subluxation (AdjOR = 11.79; CI : 5.09–27.27), uvea in the wound (AdjOR = 9.35; CI = 4.51–19.38), retinal hemorrhage (AdjOR = 8.56; CI : 2.88–25.42), total hyphema (AdjOR = 8.45; CI : 3.26–21.92); and other variables with adjOR less than 7 (Table 3). Multivariate logistic regression was performed with FVA as a dependent two-level variable. Good visual outcome was used as the referent value. The final model with the strongest set of prognostic factors included age, lens subluxation (AdjOR = 5.57; CI : 2.09–14.83), vitreous prolapse (AdjOR = 8.61; CI : 2.76–26.87), vitreous hemorrhage (AdjOR = 4.14; CI : 1.71–10.03), intraocular foreign body in posterior segment (AdjOR = 6.81; CI : 1.19–39.09), and vitritis (AdjOR = 3.28; CI : 0.97–11.12) (Table 4). The final model resulted in the following model fit statistics : AIC : 183.787, −2 Log L : 165.787, Hosmer and Lemeshow Goodness-of-Fit Test p = 0.4702, and c-statistic = 0.846.

Discussion

This study represents an observational clinical case series of heterogeneous eye-injured patients from the largest hospital in central Bosnia and Herzegovina. Our study contributes to prior research predicting final visual acuity by including closed and open globe injuries, chemical and physical injuries, and a wide range of injury severity. Prior predictive models have focused on more severe eye injuries, yet less severe injuries can also lead to poor final visual acuity.

Definitions of final visual status in prior studies have varied. The World Health Organization's Global Data on Visual Impairments divides visual impairment into two groups : moderate and severe vision impairment, together referred to as "low vision" (<6/18 > 3/60) [2]. Esmaeli at al defined "acceptable visual acuity" as 20/60 or better [22], while Sobaci et al defined "favorable" visual acuity as 5/200 or better [4]. We used an outcome definition similar to Kuhn et al [25], who analyzed 11 360 cases from an eye injury registry in the United States and proposed good visual acuity to be 20/200 or better. We used vision 20/200 as the limit to dichotomize between "poor" and "good" vision, after comparison statistics indicated better model fit than compared with five- and three- levels of visual acuity. While our results from different outcome categorizations did not differ, a two-level outcome led to more precise confidence intervals.

Older age was a risk factor for poor final visual acuity, which is consistent with global research reported by Négrel and Thylefors [1]. Sex was not significant risk factor for poor final visual acuity, although the admission ratio for males to females was seven to one, which is consistent with former studies [7,12,26]. We did not find that occupation was predictive of final visual acuity, likely because any relation would be attenuated through the eye injury characteristics.

Nearly a third of patients experienced more than 1 day in the time from injury to admission, which is far longer than the standard trauma criteria of one hour. A major challenge for trauma care in Bosnia and Herzegovina is delayed care, both in time to arrival at the first hospital and inter-hospital transfer periods. These delays are usually due to the lack of transportation, especially in distant, rural, isolated communities; or general low awareness of eye injury severity and its consequences. Weber and colleagues found adverse effects of prolonged time for injured patients to report to a hospital for treatment and found disparities in developing countries compared to industrialized countries, and also in combat ocular trauma [12, 27].

However, results of Sobaci and colleagues [4] showed no significant difference between time of primary surgical repair and visual outcome.

Many prior studies have examined the prognostic value of a single eye injury, but few have examined multivariate predictive models. Including broad diagnosis is important for accurate prediction. We found that in univariate analysis, a considerable number of diagnoses were associated with poor outcome, but few of these remained predictive in multivariate models. Our univariate results partially converged with the results published by Knyazer at al [18] where low initial visual acuity, injury of lids, iris, lens, corneal lamellar laceration, and ocular hypotonia were associated with low final visual acuity. Meng and Yan reported significance in multivariate analysis for initial vision, RAPD and injury zone in open globe injuries, and these results were similar with our univariate analysis results [9]. Sobaci and colleagues [4] reported several significant variables (rupture, no light perception, zone III injury, and RAPD) as predictors of low visual function, but showed only crude odds ratios. Han and al reported that poor initial visual acuity, retinal detachment, RAPD and wound larger than 10 mm predicted poor final visual acuity after open globe injuries using multivariate regression, while their univariate analysis demonstrated significance in vitreous hemorrhage, hyphema, lens and lid damage [8]. Yu Wai Man reported that initial vision, RAPD, laceration of eyelids, posterior wound location, and rupture predicted poor outcome [11]. Other studies found lid injury to be of equal value [15,23], while Gervasio et al. showed that lid laceration had an insignificant effect on poor visual outcome in patients with open globe injuries and facial fractures [7].

A study of combat eye trauma by Weichel et.al found univariate results consistent with ours and included macular and choroidal hemorrhage, retinal detachment, APD, and subretinal hemorrhage as predictors. However, their multiple regression results showed significant associations for only combinations of injury types, i.e., globe, oculoplastic and/or neuro-ophthalmic injury [27]. Our differing findings could be due in part to the different study

samples, which likely vary in the types and profiles of diagnoses and severity found in our patient population with combat eye injuries.

Studies have used the BETT classification system and accordingly showed injury types having unfavorable predictive value. Weichel and colleagues [27] showed significance for vision less than 20/200 in perforation, rupture, scleral, corneoscleral and corneal laceration type of injury, while our study did not show any difference in prognosis of poor visual acuity based on type of injury. Similar results were presented in study by Gervasio [7].

This study has several limitations, which included small cell sizes and biases introduced in using patients from one hospital. Several variables which showed significance in univariate analysis could not be used in multivariate regression because the cell sizes were not sufficiently large. These included retinal detachment, initial visual acuity, Ocular Trauma Score (OTS), rupture, and RAPD. Although we could not show their significant prognostic value in multivariate analysis, their distribution along the final visual acuity levels was noticeable. Their prognostic value was reported in different studies. For example, presenting low visual acuity was a significant predictor in many studies [7,8,11,21]. Our study showed that of all patients having poor final visual acuity, only 4.4 % presented with good initial visual acuity (≥20/200), while 95.9 % had initial vision less than 20/200. Although we did not use the initial visual acuity in multivariate analysis due to small cell size, prognostic value of this variable is evident. OTS has a similar strong predictive association [4,6,7,12,13,18,20], but was not included in our final model.

Our study is among the first to propose a multivariate prognostic model that integrates a broad range of eye injury mechanisms and less severe eye injuries. Former studies have not used multivariate models and thus provide estimates for individual eye injury characteristics rather than the entire diagnostic profile [4,7]. Few former studies have included less severe eye injuries, although these can also lead to poor final visual acuity. Moreover, this model uses eye injury characteristics that are frequent, whereas models such as OTS or CART are appropriate for more severe but less common diagnoses. Man and Steel reported high sensitivity and specificity of OTS and CART as predictive tools; however, they analyzed only open globe injuries [11]. Our study included open and closed globe injuries, identifying a unified prognostic tool for both types. While future studies with larger samples are needed to verify these results, this model can be helpful to physicians in predicting final visual acuity in a wide range of patients.

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Table 1.

Demographic characteristics by final visual acuity

	Final visual acuity						
	Total		NLP/LP/<20/200		≥20/200		
Demographic/Hospital Characteristics	**N**	**(%)[b]**	**N**	**(%)[b]**	**N**	**(%)[b]**	**p-value[a]**
Sex							1.000
Male	222	(87.1)	39	(86.7)	183	(87.1)	
Female	33	(12.9)	6	(13.3)	27	(12.9)	
Age							0.005
< 21	54	(12.5)	2	(4.4)	52	(24.7)	
21–35	69	(35.7)	15	(33.3)	54	(25.7)	
36–65	113	(44.3)	22	(48.9)	91	(43.3)	
65+	19	(7.5)	6	(13.3)	13	(6.2)	
Occupation							0.521
Seniors, students, housewives	82	(34.3)	14	(33.3)	68	(34.5)	
Manual force workers	84	(35.1)	17	(40.5)	67	(34.0)	
Fire and electric force workers	28	(11.7)	3	(7.1)	25	(12.7)	
Agricultural workers, farmers and lumberjacks	9	(3.8)	3	(7.1)	6	(3.0)	
Unemployed	36	(15.1)	5	(11.9)	31	(15.7)	
Time from injury to admission							0.008
Less than 24 h	169	(68.2)	38	(84.4)	131	(64.5)	
1–2 days	52	(21.0)	2	(4.4)	50	(24.6)	
3–6 days	22	(8.9)	4	(8.9)	18	(8.9)	
7+ days	5	(2.0)	1	(2.2)	4	(2.0)	
Length of stay (LOS)							0.001
1–6 days	128	(50.4)	15	(33.3)	113	(54.1)	
7–13 days	113	(44.5)	23	(51.1)	90	(43.1)	
14+ days	13	(5.1)	7	(15.6)	6	(2.9)	

[a]Fisher's exact test for testing independence between final visual acuity categories (a =0.05)

[b]Percentages based on characteristics (column %'s)

Table 2 :

Clinical variables and injury types by final visual acuity

	Final visual acuity						
	Total		NLP/LP/<20/200		≥20/200		
Clinical Characteristics	**N**	**(%)[b]**	**N**	**(%)[b]**	**N**	**(%)[b]**	**p-value[a]**
Injured lids							< 0.001
Yes	97	(38.0)	30	(66.6)	67	(31.9)	
No	158	(62.0)	15	(33.3)	143	(68.1)	
Injured sclera							< 0.001
Yes	46	(18.0)	18	(40.0)	28	(13.3)	
No	209	(82.0)	27	(60.0)	182	(86.6)	
Injured choroid							< 0.001
Yes	13	(5.1)	8	(17.7)	5	(2.4)	
No	242	(94.9)	37	(82.2)	205	(97.6)	
Injured extrabulbar muscle							< 0.001
Yes	10	(3.9)	7	(15.5)	3	(1.4)	
No	245	(96.1)	38	(84.4)	207	(98.6)	
Initial Visual Acuity							< 0.001
< 20/200	102	(40.0)	43	(95.5)	59	(28.1)	
≥20/200	153	(60.0)	2	(4.4)	151	(71.9)	
Closed Globe Injury							< 0.001
Yes	156	(61.2)	13	(28.8)	143	(68.1)	
No	99	(38.8)	32	(71.1)	67	(31.9)	
Contusion							< 0.001
Yes	140	(54.9)	13	(28.8)	127	(60.5)	
No	115	(45.1)	32	(71.2)	83	(39.5)	
Lamellar laceration							< 0.001
Yes	75	(29.4)	4	(8.9)	71	(33.8)	
No	180	(70.6)	41	(91.1)	139	(66.2)	
Open globe injury							< 0.001
Yes	99	(38.8)	32	(71.1)	67	(31.9)	
No	156	(61.2)	13	(28.8)	143	(68.1)	
Rupture[c]							< 0.001
Yes	16	(6.3)	15	(33.3)	1	(2.2)	
No	239	(93.7)	30	(66.6)	209	(97.8)	
Uvea in wound							< 0.001
Yes	53	(20.8)	26	(57.7)	27	(12.8)	
No	202	(79.2)	19	(42.2)	183	(87.1)	
Wound dehiscence							< 0.001
Yes	49	(19.2)	21	(46.6)	28	(13.3)	
No	206	(80.8)	24	(53.4)	182	(86.6)	
Total hyphema							< 0.001

	Final visual acuity						
	Total		NLP/LP/<20/200		≥20/200		
Clinical Characteristics	**N**	**(%)[b]**	**N**	**(%)[b]**	**N**	**(%)[b]**	**p-value[a]**
Yes	21	(8.3)	12	(26.6)	9	(4.3)	
No	233	(91.7)	33	(73.4)	201	(95.7)	
Iridodialysis							< 0.001
Yes	34	(13.4)	21	(46.6)	13	(6.2)	
No	220	(86.6)	24	(53.4)	196	(93.3)	
Traumatic cataract							0.004
Yes	31	(12.2)	12	(26.6)	19	(9.1)	
No	224	(87.8)	33	(73.3)	191	(90.9)	
Lens subluxation							< 0.001
Yes	36	(14.1)	21	(46.6)	15	(7.1)	
No	219	(85.9)	24	(53.4)	195	(92.8)	
Vitreous hemorrhage							< 0.001
Yes	43	(16.9)	18	(40.0)	25	(11.9)	
No	212	(83.1)	27	(60.0)	185	(88.1)	
Vitreous prolapse							< 0.001
Yes	24	(9.4)	16	(35.5)	8	(3.8)	
No	231	(90.6)	29	(64.5)	202	(96.2)	
Retinal Detachment[c]							< 0.001
Yes	10	(3.9)	10	(22.2)	0	(0.0)	
No	245	(96.0)	35	(77.7)	210	(100.0)	
Retinal hemorrhage							< 0.001
Yes	16	(6.3)	9	(20.0)	7	(3.3)	
No	239	(93.7)	36	(80.0)	203	(96.6)	
Macular hemorrhage							0.041
Yes	12	(4.7)	5	(11.1)	7	(3.3)	
No	243	(95.3)	40	(88.9)	203	(96.7)	
Vitritis							0.005
Yes	18	(7.1)	8	(17.7)	10	(4.7)	
No	237	(92.9)	37	(82.3)	200	(95.3)	
RAPD[c]							< 0.001
Yes	16	(6.3)	16	(35.5)	0	(0.0)	
No	239	(93.7)	29	(64.5)	239	(100.0)	
Injury zone							< 0.001
Zone 1	98	(38.4)	4	(8.8)	94	(44.8)	
Zone 2	88	(34.5)	14	(31.1)	74	(35.2)	
Zone 3	69	(27.1)	27	(60.0)	42	(20.0)	
OTS[c]							< 0.001
1,2 3	88	(34.5)	44	(97.7)	44	(21.0)	
4, 5	167	(65.5)	1	(2.2)	166	(79.0)	

[a] Fisher's exact test for testing independence between final visual acuity categories ($\alpha = 0.05$)

[b] Percentages based on characteristics (column %'s)

[c] Excluded from multivariate model due to small cell sizes

Table 3.

Clinical characteristics associated with poor visual outcome

Clinical Characteristics	Crude OR	95 % CI	Adj. OR[a]	95 % CI
Injury Zone				
Zone 1	Ref		Ref	
Zone 2	4.45	1.41 – 14.07	4.42	1.39 – 14.06
Zone 3	15.11	4.97 – 45.90	16.45	5.33 – 50.76
Vitreous Prolapse				
Yes	13.93	5.48 – 35.44	14.07	5.42 – 36.51
No	Ref		Ref	
Iridodialysis				
Yes	13.19	5.86 – 29.69	13.51	5.83 – 31.31
No	Ref		Ref	
Lens Subluxation				
Yes	11.38	5.18 – 24.98	11.79	5.09 – 27.27
No	Ref		Ref	
Uvea in the Wound				
Yes	9.28	4.53 – 18.99	9.35	4.51 – 19.38
No	Ref		Ref	
Retinal Hemorrhage				
Yes	7.25	2.54 – 20.71	8.56	2.88 – 25.42
No	Ref		Ref	
Total Hyphema				
Yes	8.38	3.27 – 21.47	8.45	3.26 – 21.92
No	Ref		Ref	
IOF Posterior				
Yes	6.43	1.66 – 25.01	6.87	1.72 – 27.48
No	Ref		Ref	
Wound Dehiscence				
Yes	5.69	2.80 – 11.54	6.31	3.03 – 13.14
No	Ref		Ref	
Vitreous Hemorrhage				
Yes	4.93	2.38 – 10.21	5.33	2.52 – 11.28
No	Ref		Ref	
Macular Hemorrhage				
Yes	3.62	1.09 – 11.99	4.97	1.31 – 18.81
No	Ref		Ref	
Injured Lids				
Yes	4.27	2.15 – 8.46	4.23	2.12 – 8.44
No	Ref		Ref	
Vitritis				
Yes	4.42	1.64 – 11.96	4.17	1.53 – 11.40

Clinical Characteristics	Crude OR	95 % CI	Adj. OR[a]	95 % CI
No	Ref		Ref	
Lamellar Laceration				
Yes	0.19	0.07 – 0.55	0.16	0.05 – 0.48
No	Ref		Ref	

[a]Controlled for age and sex

Table 4.

Clinical characteristics associated with poor visual outcome : multivariate model

Clinical Characteristics	Crude OR	95 % CI	Adj. OR[a]	95 % CI
Age				
< 36	Ref		Ref	
36–65	1.51	0.75 – 3.01	1.75	0.75 – 4.09
65+	2.88	0.96 – 8.60	1.21	0.25 – 5.84
Lens Subluxation				
Yes	11.38	5.18 – 24.98	5.57	2.09 – 14.83
No	Ref		Ref	
Vitreous Prolapse				
Yes	13.93	5.48 – 35.44	8.61	2.76 – 26.87
No	Ref		Ref	
Vitreous Hemorrhage				
Yes	4.93	2.38 – 10.21	4.14	1.71 – 10.03
No	Ref		Ref	
Vitritis				
Yes	4.42	1.64 – 11.96	3.28	0.97 – 11.12
No	Ref		Ref	
IOF Posterior				
Yes	6.43	1.65 – 25.02	6.81	1.19 – 39.09
No	Ref		Ref	
Macular Hemorrhage				
Yes	3.62	1.09 – 11.99	1.32	0.28 – 6.23
No	Ref		Ref	

[a]Adjusting for all variables in the table