

Clinical characteristics and prognostic factors for visual outcome in 669 patients with intraocular foreign bodies

Yu-Zhu Gao¹, Yi-Fan Zhang¹, Ming Zhang¹, Han-Yue Xu¹, Xu-Rui Jin²

¹Department of Ophthalmology, West China Hospital, Sichuan University, Chengdu 610041, Sichuan Province, China

²Duke Global Health Research Institute, 310 Trent Drive, Durham, NC 27710, Box 905119, Durham, NC 27708, USA

Correspondence to: Ming Zhang. Department of Ophthalmology, West China Hospital, Sichuan University, Chengdu 610041, Sichuan Province, China. mingzhangscu@163.com

Received: 2020-06-10 Accepted: 2020-08-06

Abstract

• **AIM:** To describe the clinical characteristics and analyze prognostic factors that influence visual outcome in 669 patients with intraocular foreign bodies (IOFBs).

• **METHODS:** Medical records of 669 patients with IOFBs from West China Hospital were reviewed. Best corrected visual acuity (BCVA) values were recorded using standard Snellen acuity chart and were converted to logarithm of the minimum angle of resolution (logMAR) scale for statistical analysis. The visual outcome was defined by the final BCVA (excellent visual outcome: final BCVA of 20/40 or better; poor visual outcome: final BCVA less than 20/200). Statistical analysis of collected data was performed using IBM SPSS Statistics version 23. A 2-tailed *P* value of less than 0.05 was considered statistically significant throughout the study.

• **RESULTS:** The average age ranged from 1 to 79 years old (mean age, 34.8±12.7 SD) and the majority of patients were men (626, 93.6%). The major cause of ocular injury was hammering (383, 57.2%). Almost all the patients (97.8%) underwent surgeries (97.8%) and the average time interval between injury and surgery was 26.4±322.3d (0-7300), while 327 patients received surgeries within 24h (48.9%) and 590 patients received surgeries within seven days (88.2%) after IOFBs injury. The poor BCVA was associated with older age (*P*=0.013), larger IOFBs size (*P*<0.001), presence of complications (*P*<0.001) and worse presenting BCVA (*P*<0.001). On the contrary, younger age (*P*=0.005), smaller IOFBs size (*P*<0.001), absence of complications (*P*<0.001) and better presenting BCVA (*P*<0.001) were considered to relate to excellent BCVA.

• **CONCLUSION:** Multiple prognostic factors may influence the final visual outcome, including age, size of

IOFBs, complications and presenting BCVA. Meanwhile, further education and promotion on eye protection should be taken for the improvement on self-protection and self-health awareness.

• **KEYWORDS:** intraocular foreign bodies; prognostic factors; visual outcome

DOI:10.18240/ijo.2021.05.18

Citation: Gao YZ, Zhang YF, Zhang M, Xu HY, Jin XR. Clinical characteristics and prognostic factors for visual outcome in 669 patients with intraocular foreign bodies. *Int J Ophthalmol* 2021;14(5):759-765

INTRODUCTION

Intraocular foreign bodies (IOFBs) is one of the leading causes of ocular disorder and visual loss worldwide^[1], which occurs mainly in young men at the working place^[2-3]. The IOFBs can both cause direct mechanical damage and lead to different intraocular pathology because of complicated nature, resulting in a wide range of complications, which poses complex challenges to the ophthalmologist in evaluation and management for patients.

Some previous studies have presented the characteristics of IOFBs as predictive factors, suggesting their association with visual outcome and management. However, most of them were conducted among the western population and with a limited sample size. Considering the high prevalence of IOFBs in China, it is essential to present the study about the current IOFBs situation.

In this study, we included 669 IOFBs cases from West China Hospital from June 2011 to September 2017 and investigated clinical characteristics of IOFBs and potential prognostic factors influencing the visual outcome.

SUBJECTS AND METHODS

Ethical Approval This retrospective study included 669 patients with IOFBs from West China Hospital between June 2011 and September 2017. This study was approved by Ethics Committee of West China Hospital of Sichuan University and conducted in compliance with guidelines of the Declaration of Helsinki. Informed consent was waived due to the retrospective nature of the study.

Patients were excluded with a history of prior disease-related vision loss, ocular disease or ocular trauma, leading to a final sample of 669 patients. The medical history and ophthalmologic examination of the patients were collected. Patients' age, gender, mechanism of injury, entry site, characteristics of IOFBs, the time interval between injury and surgery, presenting and final best corrected visual acuities (BCVA) and complications were collected.

BCVA values were recorded using standard Snellen acuity chart and were converted to logarithm of the minimum angle of resolution (logMAR) scale for statistical analysis. The presenting BCVA was taken at patients' first presenting to West China Hospital while the final BCVA was recorded during follow-up. The visual outcome was defined by the final BCVA (excellent visual outcome: final BCVA of 20/40 or better; poor visual outcome: final BCVA less than 20/200).

Characteristics of the IOFBs included size, location, and nature. The size of IOFBs was divided into three groups: small (less than 4 mm²), medium (4-16 mm²) and large (more than 16 mm²). Depending on the suspected location and nature of IOFBs, different ocular imaging including B-scan ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI) was used for detection at the initial visit.

The Ocular Trauma Score (OTS)^[4] was used in this study for patients >15 years of age, which was calculated by summing the raw points based on the following parts: initial vision (no light perception=60 raw points, light perception or hand motion perception=70 raw points, 1/200 to 19/200=80 raw points, 20/200 to 20/40=90 raw points, \geq 20/40=100 raw points), and five injury related factors (rupture=minus 23 raw points; endophthalmitis=minus 17 raw points; perforating injury=minus 14 raw points; retinal detachment=minus 11 raw points; and afferent papillary defect (RAPD)=minus 10 raw points). For patients \leq 15 years of age, since RAPD could not be evaluated in most of them, the pediatric Penetrating Ocular Trauma Score (POTS)^[5] was calculated for evaluation, which includes four parts: initial visual acuity (no light perception=10 raw points, light perception or hand motion perception=20 raw points, counting fingers=30 raw points, 0.1-0.5=40 raw points, 0.6-1.0=50 raw points), age of the pediatric patients (0-5 years old=10 raw points, 6-10 years old=15 raw points, 11-15 years old =25 raw points), wound location (zone I=25 raw points, zone II=15 raw points, zone III=10 raw points) and concomitant eye pathologies [iris prolapse=minus 5 raw points, hyphema=minus 5 raw points, organic/unclean injury=minus 5 raw points, delay of surgery (>48h)=minus 5 raw points, traumatic cataract= minus 10 raw points, vitreous hemorrhage= minus 20 raw points, retinal detachment=minus 20 raw points, endophthalmitis=minus 30 raw points]. For patients whose initial visual acuity was not obtained, the following equation

was used for adjustment: $2 \times (\text{age} + \text{zone})$ —corresponding pathologies. Three different groups were compared, which were categorized by final BCVA: Group I (189 eyes): final BCVA was equal to or better than 20/40 Snellen E; Group II (98 eyes): final BCVA was between 20/40 and 20/200 Snellen E; Group III (382 eyes): final BCVA was less than 20/200 Snellen E.

Statistical Analysis Statistical analysis of collected data was performed using IBM SPSS Statistics version 23 (SPSS Inc., Chicago, IL, USA). Baseline characteristics were presented as a mean (continuous variables) or on a frequency distribution (categorical variables). ANOVA for continuous variables and Chi-square tests for categorical variables were applied to compare the differences among participants with IOFBs. Univariate and multivariate Logistics regression were applied to examine the associations between prognostic factors and visual outcome. A 2-tailed *P* value of less than 0.05 was considered statistically significant throughout the study.

RESULTS

Clinical Characteristics of the Patients with IOFBs Totally 669 patients (669 eyes) were included in this study. Baseline demographic and clinical characteristics for these patients and study eyes were presented in Table 1. The average age ranged from 1 to 79 years old (mean age, 34.8 \pm 12.7 SD) and there were more males (626, 93.6%) than females (43, 6.4%). The injuries occurred in 328 left eyes (49.0%) and 341 right eyes (51.0%). Hammering (383, 57.2%) was observed to be the most common cause of IOFBs. The entry sites were from cornea (441, 65.9%), sclera (174, 26.0%) and limbus (54, 8.1%).

Totally 55 patients (8.2%) wore eye protection at the time of getting injury and there was significant difference in three groups (*P*=0.012). In Group I, 58 patients (30.7%) presented with the presenting BCVA better than 20/40, which was significantly more than 13 patients in Group II (13.3%) and 26 patients in Group III (6.8%). The complications were present in the majority of patients (77.3%), however, there was significant difference in the three groups: the complications were present in 74 patients in Group I (39.2%), while nearly in all patients in Group II (84.7%) and Group III (*P*<0.001). While the average time interval between injury and surgery was 26.4 \pm 322.3d (0-7300), it was significantly shorter in Group I (2.7 \pm 4.6) than in Group II (3.5 \pm 7.1) and Group III (*P*<0.001). Almost half of patients received surgeries within 24h (327, 48.9%) and most patients received surgeries within seven days (590, 88.2%).

Characteristics of Intraocular Foreign Bodies The characteristics of IOFBs were illustrated in Table 2, including size, location, and nature. The size of the IOFBs varied as follows: small (\leq 4 mm²), 25.7%; medium (4-16 mm²), 26.3%; large (>16 mm²), 29.8% and unclear size, 18.2%, where there was significant difference in three groups (*P*<0.001). The

Table 1 Clinical characteristics of the patients with IOFBs

Clinical characteristics	Group I final BCVA ≥20/40 (189 eyes)	Group II final BCVA 20/40-20/200 (98 eyes)	Group III final BCVA <20/200 (382 eyes)	Total
Age (y, range)	30.9±12.8 (1-76)	34.4±10.8 (8-65)	36.8±12.7 (2-79)	34.8±12.7 (1-79)
Male/female, n (%)	179 (94.7)/10 (5.3)	90 (91.8)/8 (8.2)	357 (93.5)/25 (6.5)	626 (93.6)/43 (6.4)
Left/right, n (%)	81 (42.9)/108 (57.1)	57 (58.2)/41 (41.8)	189 (49.5)/193 (50.5)	328 (49.0)/341 (51.0)
Entry site, n (%)				
Cornea	126 (66.7)	72 (73.5)	243 (63.6)	441 (65.9)
Sclera	45 (23.8)	20 (20.4)	109 (28.5)	174 (26.0)
Limbus	18 (9.5)	6 (6.1)	30 (7.9)	54 (8.1)
Mechanism, n (%)				
Hammering	115 (60.8)	47 (48.0)	221 (57.9)	383 (57.2)
Chiseling	15 (7.9)	12 (12.2)	33 (8.6)	60 (9.0)
Drilling	13 (6.9)	9 (9.2)	35 (9.2)	57 (8.5)
Explosion	14 (7.4)	10 (10.2)	30 (7.9)	54 (8.1)
Fireworks	10 (5.3)	7 (7.1)	28 (7.3)	45 (6.7)
Wood injury	12 (6.3)	8 (8.2)	20 (5.2)	40 (6.0)
Pellet gun	7 (3.7)	3 (3.1)	10 (2.6)	20 (3.0)
Unknow	3 (1.6)	2 (2.0)	5 (1.3)	10 (1.5)
Eyes protection				
Yes	23 (12.2)	11 (11.2)	21 (5.5)	55 (8.2)
No	166 (87.8)	87 (88.8)	361 (94.5)	614 (91.8)
Presenting BCVA				
≥20/40	58 (30.7)	13 (13.3)	26 (6.8)	97 (14.5)
20/40-20/200	29 (15.3)	19 (19.4)	27 (7.1)	75 (11.2)
<20/200	102 (54.0)	66 (67.3)	329 (86.1)	497 (74.3)
Complications				
Absence	115 (60.8)	15 (15.3)	22 (5.8)	152 (22.7)
Presence	74 (39.2)	83 (84.7)	360 (94.2)	517 (77.3)
Time interval between injury and surgery				
Mean, d	2.7±4.6	3.5±7.1	37.5±385.3	26.4±322.3
<24h	111 (58.7)	55 (56.1)	161 (42.1)	327 (48.9)
24h-7d	71 (37.6)	32 (32.7)	160 (41.9)	263 (39.3)
≥7d	7 (3.7)	11 (11.2)	61 (16.2)	79 (11.8)

IOFBs: Intraocular foreign bodies; BCVA: Best corrected visual acuity.

IOFBs were located mostly in the retina in 165 eyes (24.7%), vitreous body in 144 eyes (21.5%) and cornea or sclera in 107 eyes (16.0%) while there was significant difference in three groups ($P=0.001$). The nature of the IOFBs showed a variety of properties, including metallic (85.7%) consisting of magnetic (74.7%) and nonmagnetic (11.0%) and nonmetallic (14.3%) comprising of glass (5.8%), wood (4.6%), plastic (2.4%) and stone (1.5%), where there was no significant difference in three groups ($P=0.776$).

Final BCVA Based on the Ocular Trauma Score or Pediatric Penetrating Ocular Trauma Score The final BCVA based on the OTS or pediatric POTS were shown in the Table 3. The POTS was used in 39 patients and the OTS was used in 630 patients. The patients were divided into five groups based on the sum of raw points: <45 points (149, 22.3%),

45-64 points (318, 47.5%), 65-79 points (50, 7.5%), 80-89 points (46, 6.9%) and 90-100 points (106, 15.8%). There was significant difference among these groups ($P<0.001$).

Complications The complications of these patients with IOFBs were summarized (Table 4). Among those patients, more than one kind of complications occurred. Further analysis of the data showed a variety of complications: lens injury occurred in more than a half eyes, including cataract in 382 eyes (57.1%), lens subluxation in 12 eyes (1.8%) and lens dislocation in 5 eyes (0.7%). Other main complications included endophthalmitis in 195 eyes (29.1%), vitreous hemorrhage in 56 eyes (8.4%) and retinal injury consisting of retinal detachment in 39 eyes (5.8%), retinal break in 14 eyes (2.1%), siderosis bulbi in 7 eyes (1.0%), retinal contusion in 5 eyes (0.7%) and retinal hemorrhage in 4 eyes (0.6%).

Features and prognostic factors in IOFBs patients

Table 2 Characteristics of IOFBs

Characteristics of IOFBs	Final BCVA \geq 20/40	Final BCVA 20/40-20/200	Final BCVA $<$ 20/200	Total	<i>n</i> (%)
					<i>P</i>
Size					$<$ 0.001
Small (\leq 4 mm ²)	95 (50.3)	35 (35.7)	42 (11.0)	172 (25.7)	
Medium (4-16 mm ²)	43 (22.8)	37 (37.8)	96 (25.1)	176 (26.3)	
Large ($>$ 16 mm ²)	16 (8.5)	10 (10.2)	173 (45.3)	199 (29.8)	
Unclear	35 (18.5)	16 (16.3)	71 (18.6)	122 (18.2)	
Location					0.001
Cornea or sclera	27 (14.3)	18 (18.4)	62 (16.2)	107 (16.0)	
Anterior chamber	16 (8.5)	7 (7.1)	28 (7.3)	51 (7.6)	
Lens	22 (11.6)	13 (13.3)	53 (13.9)	88 (12.9)	
Vitreous body	45 (23.8)	20 (20.4)	79 (20.7)	144 (21.5)	
Retina	50 (26.5)	19 (19.4)	96 (25.1)	165 (24.7)	
Penetrating	18 (9.5)	13 (13.3)	34 (8.9)	65 (9.7)	
Unclear	11 (5.8)	8 (8.2)	30 (7.9)	49 (7.3)	
Nature					0.776
Metallic					
Magnetic	148 (78.3)	77 (78.6)	275 (72.0)	500 (74.7)	
Nonmagnetic	12 (6.3)	9 (9.2)	52 (13.6)	73 (11.0)	
Nonmetallic					
Glass	11 (5.8)	6 (6.1)	22 (5.8)	39 (5.8)	
Wood	9 (4.8)	3 (3.1)	19 (5.0)	31 (4.6)	
Plastic	6 (3.2)	2 (2.0)	8 (2.1)	16 (2.4)	
Stone	3 (1.6)	1 (1.0)	6 (1.6)	10 (1.5)	

BCVA: Best corrected visual acuity.

Table 3 Final BCVA based on OTS or POTS

Sum of raw points	Final BCVA \geq 20/40	Final BCVA 20/40-20/200	Final BCVA $<$ 20/200	Total	<i>P</i>
$<$ 45	29 (15.3)	17 (17.3)	103 (27.0)	149 (22.3)	$<$ 0.001
45-64	61 (32.3)	45 (45.9)	212 (55.5)	318 (47.5)	
65-79	23 (12.2)	10 (10.2)	17 (4.5)	50 (7.5)	
80-89	27 (14.3)	4 (4.1)	15 (3.9)	46 (6.9)	
90-100	49 (26.0)	22 (22.4)	35 (9.2)	106 (15.8)	

BCVA: Best corrected visual acuity; OTS: Ocular Trauma Score; POTS: Penetrating Ocular Trauma Score.

Prognostic Factors for the Visual Outcome According to

Univariate Analysis Univariate analysis was performed to detect the prognostic factors for the visual outcome. The result (Table 5) revealed that the poor visual outcome (final BCVA $<$ 20/200) was associated with older age ($P<$ 0.001), worse presenting BCVA (presenting BCVA $<$ 20/200; $P<$ 0.001), larger size of IOFBs ($P<$ 0.001), presence of complications ($P<$ 0.001), longer time interval from injury to surgery ($P=$ 0.004). For the excellent visual outcome (final BCVA $>$ 20/40), younger age ($P<$ 0.001), better presenting BCVA (presenting BCVA \geq 20/40; $P<$ 0.001), the smaller size of IOFBs ($P<$ 0.001), absence of complications ($P<$ 0.001) and the shorter time interval from injury to surgery ($P=$ 0.021) were significantly prognostic factors (Table 6).

Prognostic Factors for the Visual Outcome According to Multivariate Analysis Multivariate analysis was conducted to

identify the prognostic factors influencing the visual outcome. The poor BCVA was associated with older age ($P=$ 0.013), worse presenting BCVA ($P<$ 0.001), the larger size of IOFBs ($P<$ 0.001) and presence of complications ($P<$ 0.001; Table 7). On the contrary, younger age ($P=$ 0.005), smaller size of IOFBs ($P<$ 0.001), absence of complications ($P<$ 0.001) and better presenting BCVA ($P<$ 0.001) were considered to relate to excellent BCVA (Table 8).

DISCUSSION

IOFBs injury is a significant, preventable health problem all over the world, especially in developing countries. It requires detailed evaluation and skillful management. In this retrospective study, we have provided comparably large and recent cases of the patients with IOFBs from West China Hospital and presented the clinical characteristics of these patients and potential prognostic factors associated with visual outcome.

Table 4 Complications

Types	Number (%)
Endophthalmitis	195 (29.1)
Orbital cellulitis	7 (1.0)
Leukoma	4 (0.6)
Glaucoma	13 (2.0)
Anterior chamber	
Hyphema	35 (5.2)
Hypopyon	2 (0.3)
Uveitis	2 (0.3)
Iris injury	
Iridorhexis	20 (3.0)
Iridodialysis	6 (0.9)
Detachment of choroid	7 (1.0)
Lens injury	
Cataract	382 (57.1)
Lens subluxation	12 (1.8)
Lens dislocation	5 (0.7)
Vitreous hemorrhage	56 (8.4)
Retinal injury	
Retinal break	14 (2.1)
Retinal detachment	39 (5.8)
Retinal hemorrhage	4 (0.6)
Retinal contusion	5 (0.7)
Siderosis bulbi	7 (1.0)
Nerves or vessels injury	
Optic nerve injury	3 (0.4)
Retinal veins occlusion	1 (0.1)

Table 5 Prognostic factors for poor visual outcome according to univariate analysis

Prognostic factors	P	OR	95%CI
Age	<0.001	1.034	1.019-1.049
Worse presenting BCVA	<0.001	1.812	1.549-2.119
Larger size of IOFBs	<0.001	4.482	3.436-5.845
Presence of complications	<0.001	13.971	8.138-23.983
Longer time interval	0.004	1.065	1.021-1.111

BCVA: Best corrected visual acuity; IOFBs: Intraocular foreign bodies.

Table 6 Prognostic factors for excellent visual outcome according to univariate analysis

Prognostic factors	P	OR	95%CI
Age	<0.001	0.965	0.950-0.980
Better presenting BCVA	<0.001	1.809	1.553-2.108
Smaller size of IOFBs	<0.001	3.769	2.844-4.995
Absence of complications	<0.001	19.328	11.833-31.571
Shorter time interval	0.021	0.940	0.893-0.991

BCVA: Best corrected visual acuity; IOFBs: Intraocular foreign bodies.

Table 7 Prognostic factors for poor visual outcome according to multivariate analysis

Prognostic factors	P	OR	95%CI
Age	0.013	1.024	1.005-1.043
Worse presenting BCVA	<0.001	4.114	3.035-5.575
Larger size of IOFBs	<0.001	10.662	5.752-19.763
Presence of complications	<0.001	1.599	1.314-1.946

BCVA: Best corrected visual acuity; IOFBs: Intraocular foreign bodies.

Table 8 Prognostic factors for excellent visual outcome according to multivariate analysis

Prognostic factors	P	OR	95%CI
Age	0.005	0.969	0.948-0.990
Better presenting BCVA	<0.001	1.576	1.290-1.924
Smaller size of IOFBs	<0.001	3.394	2.387-4.825
Absence of complications	<0.001	16.677	9.443-29.456

BCVA: Best corrected visual acuity; IOFBs: Intraocular foreign bodies.

Prevalence As it was consistent with prior studies that young men constitute 87.5%-100% of the patients presenting with IOFBs^[6-7], our study demonstrated that our patients were relatively young when they got injured (mean, 34.8y) and the majority of them were males (93.6%). The result also suggested that the injury occur in the right and left eyes of virtually the same possibility. In our study, hammering was considered to be the most common cause of injury (57.2%), which was also demonstrated by Liu *et al* (52.6%)^[8] and Ehlers *et al* (58%)^[9]. We also found that our patients were lack of wearing eye-protection (8.2%), similar to what reported by Parver *et al* (10%)^[10]. In consideration of the fact that the majority of IOFBs injury happens in the workplace, precautionary measurements are suggested to be taken in to reduce the incidence of IOFBs injury. It is worth noting that the significance of wearing eye protection such as safety glasses. Additionally, we have also noticed that some patients were in poverty and deficiency of self-protection and self-health awareness. In view of those cases, it seems that more efforts are required to spend on the relevant education.

In addition, the time interval of IOFBs removal was recommended within 24h, which was founded to be associated with visual outcome in the previous studies^[8,11]. Our study showed that almost half patients received surgeries within 24h and most patients received surgeries within seven days. In this study, the average time interval between injury and surgery seemed to be longer than that reported in previous studies. However, it depends on several factors. One of the main factors is that in normal conditions, most patients went

to hospital nearby which lack of operating rooms and surgeons at the time of injury, which inevitably prolonged the time interval. As reported in previous studies, the availability of experienced surgeons and operating rooms play a significant role^[12]. Jonas *et al*^[11] suggested the surgery should be delayed until trained surgeons available in some clinical situation especially in patients with metallic IOFBs. What's more, for some older patients, overall health status should be taken into consideration, if a patient is not in a good condition, the delaying of surgery is also recommended for a better prognosis.

Many studies considered the OTS and pediatric POTS as effective tools for evaluation and suggested that they were helpful in the prediction of final visual outcome^[5,13-14]. In this study, the OTS system and the pediatric POTS system were also used for evaluation of patients with IOFBs and we also founded that in our 669 patients, the OTS and POTS were related to final BCVA.

Management Our study suggested that detailed history of patients with IOFBs should be the significant part in the management of IOFBs, if it is reliable, the patients' perspective may thus be useful for further evaluation and decision making. Moreover, as one of the significant parts in the management of IOFBs, CT is a recommended method used in patients' examination and evaluation in previous studies^[2]. Lin *et al*^[15] also reported that the sensitivity of the CT image was 90% in the detection of IOFBs and considered CT scan as an important tool in planning the surgical procedures. In our patients, ocular imaging was applied in the majority of the patients with IOFBs for diagnosis and management, and CT scan was the preferred method. Moreover, MRI was also performed in some of our patients when CT missed in the detection of some tiny ferromagnetic IOFBs.

Almost all the patients received surgeries for IOFBs removal and global repair. As shown in the previous study, the closure of the entry site, the removal of the IOFBs and the prevention treatment of endophthalmitis were considered to be on the priority during surgery^[16]. Moreover, in some cases, additional surgeries were required for the reconstruction of eyeballs, such as cataract removal and intraocular lens (IOL) implantation when presence of lens injuries.

Prognostic Factors In our study, univariate and multivariate analyses revealed that several factors seemed to be related to visual outcome in patients with IOFBs. We found that age was related to visual outcome. Szijártó *et al*^[17], Liu *et al*^[8], and Yang *et al*^[18] have reported that the larger IOFBs was considered to be associated with poor prognosis. We found that the larger size of IOFBs was a significant prognostic factor associated with poor visual outcome and the smaller size of IOFBs was related to excellent visual outcome. Clearly, the larger size of

IOFBs suggests the possibility of increasing mass and velocity, proportional to the energy transmitted to eyes, leading to worse tissue damage and worse visual outcome.

Our finding that the presence of complications was significantly related to the visual outcome, which is similar to what reported previously^[8]. Considering that the type of complications varies in patients with IOFBs, it is of great importance to clarify the various types during evaluation process. Previous studies suggested that some complications like endophthalmitis^[8,19], proliferative vitreoretinopathy^[17,20] and retinal detachment^[20-21] were predictive of poor visual outcome. Nevertheless, Chiquet *et al*^[21] have indicated hyphema and vitreous hemorrhage did not affect the prognosis in patients with IOFBs. A recent study by Ma *et al*^[22] has demonstrated that for patients with complications like traumatic cataract and vitreous hemorrhage, if the macula of them remained integrity, the visual acuity could be improved after IOFBs removal.

Previous studies have demonstrated the importance of presenting BCVA as a prognostic factor in patients with IOFBs^[8,16,23]. In our study, better presenting BCVA were also considered to be a prognostic factor for the excellent visual outcome.

Limitations and Advantages Our study has further limitations. First, our patients were all from West China Hospital, hence, the situations may differ in other regions. Second, all data were collected through a retrospective review of medical records, leading to the limited information. The primary strength of this study is that the relatively large-scale and recent data were generated. Second, considerably complete data were used both in univariate and multivariate analyses to explore prognostic factors involved in the visual outcome. In addition, considering the significance of the improvement on self-protection and self-health awareness, we also performed a lack of eye protection, which was rarely reported by recent studies.

In this study, we found that multiple prognostic factors might influence the final visual outcome, including age, size of IOFBs, complications and presenting BCVA. Meanwhile, considering that visual outcome is directly related to patients' daily activities, further education and promotion on eye protection should be taken for improvement on self-protection and self-health awareness. Since the patients presenting with IOFBs injury are challengeable and sometimes complicated for the ophthalmologist, we also hope our experience could help them in further work in IOFBs.

ACKNOWLEDGEMENTS

Conflicts of Interest: Gao YZ, None; Zhang YF, None; Zhang M, None; Xu HY, None; Jin XR, None.

REFERENCES

- 1 Négrel AD, Thylefors B. The global impact of eye injuries. *Ophthalmic Epidemiol* 1998;5(3):143-169.

- 2 Loporchio D, Mukkamala L, Gorukanti K, Zarbin M, Langer P, Bhagat N. Intraocular foreign bodies: a review. *Surv Ophthalmol* 2016;61(5):582-596.
- 3 AlMahmoud T, Al Hadhrami SM, Elhanan M, Alshamsi HN, Abu-Zidan FM. Epidemiology of eye injuries in a high-income developing country: an observational study. *Medicine (Baltimore)* 2019;98(26):e16083.
- 4 Kuhn F, Maisiak R, Mann L, Mester V, Morris R, Witherspoon CD. The ocular trauma score (OTS). *Ophthalmol Clin North Am* 2002;15(2):163-165.
- 5 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):370-374.
- 6 Greven CM, Engelbrecht NE, Slusher MM, Nagy SS. Intraocular foreign bodies: management, prognostic factors, and visual outcomes. *Ophthalmology* 2000;107(3):608-612.
- 7 Fulcher TP, McNab AA, Sullivan TJ. Clinical features and management of intraorbital foreign bodies. *Ophthalmology* 2002;109(3):494-500.
- 8 Liu Y, Wang S, Li Y, Gong QY, Su GF, Zhao JS. Intraocular foreign bodies: clinical characteristics and prognostic factors influencing visual outcome and globe survival in 373 eyes. *J Ophthalmol* 2019;2019:5208092.
- 9 Ehlers JP, Kunimoto DY, Ittoop S, Maguire JI, Ho AC, Regillo CD. Metallic intraocular foreign bodies: characteristics, interventions, and prognostic factors for visual outcome and globe survival. *Am J Ophthalmol* 2008;146(3):427-433.
- 10 Parver LM, Dannenberg AL, Blacklow B, Fowler CJ, Brechner RJ, Tielsch JM. Characteristics and causes of penetrating eye injuries reported to the National Eye Trauma System Registry, 1985-91. *Public Health Rep* 1993;108(5):625-632.
- 11 Jonas JB, Knorr HL, Budde WM. Prognostic factors in ocular injuries caused by intraocular or retrobulbar foreign bodies. *Ophthalmology* 2000;107(5):823-828.
- 12 Woodcock MG, Scott RA, Huntbach J, Kirkby GR. Mass and shape as factors in intraocular foreign body injuries. *Ophthalmology* 2006;113(12):2262-2269.
- 13 Zhu LL, Shen PY, Lu H, Du CX, Shen JQ, Gu YS. Ocular trauma score in siderosis bulbi with retained intraocular foreign body. *Medicine (Baltimore)* 2015;94(39):e1533.
- 14 Cillino S, Casuccio A, di Pace F, Pillitteri F, Cillino G. A five-year retrospective study of the epidemiological characteristics and visual outcomes of patients hospitalized for ocular trauma in a Mediterranean area. *BMC Ophthalmol* 2008;8:6.
- 15 Lin TC, Liao TC, Yuan WH, Lee FL, Chen SJ. Management and clinical outcomes of intraocular foreign bodies with the aid of orbital computed tomography. *J Chin Med Assoc* 2014;77(8):433-436.
- 16 Nicoară SD, Irimescu I, Călinici T, Cristian C. Intraocular foreign bodies extracted by pars plana vitrectomy: clinical characteristics, management, outcomes and prognostic factors. *BMC Ophthalmol* 2015;15:151.
- 17 Sziártó Z, Gaál V, Kovács B, Kuhn F. Prognosis of penetrating eye injuries with posterior segment intraocular foreign body. *Graefes Arch Clin Exp Ophthalmol* 2008;246(1):161-165.
- 18 Yang CS, Hsieh MH, Hou TY. Predictive factors of visual outcome in posterior segment intraocular foreign body. *J Chin Med Assoc* 2019;82(3):239-244.
- 19 Li L, Lu H, Ma K, Li YY, Wang HY, Liu NP. Etiologic causes and epidemiological characteristics of patients with intraocular foreign bodies: retrospective analysis of 1340 cases over ten years. *J Ophthalmol* 2018;2018:6309638.
- 20 Wickham L, Xing W, Bunce C, Sullivan P. Outcomes of surgery for posterior segment intraocular foreign bodies—a retrospective review of 17 years of clinical experience. *Graefes Arch Clin Exp Ophthalmol* 2006;244(12):1620-1626.
- 21 Chiquet C, Zech JC, Gain P, Adeleine P, Trepsat C. Visual outcome and prognostic factors after magnetic extraction of posterior segment foreign bodies in 40 cases. *Br J Ophthalmol* 1998;82(7):801-806.
- 22 Ma J, Wang Y, Zhang L, Chen M, Ai J, Fang XY. Clinical characteristics and prognostic factors of posterior segment intraocular foreign body in a tertiary hospital. *BMC Ophthalmol* 2019;19(1):17.
- 23 Chaudhry IA, Shamsi FA, Al-Harathi E, Al-Theeb A, Elzaridi E, Riley FC. Incidence and visual outcome of endophthalmitis associated with intraocular foreign bodies. *Graefes Arch Clin Exp Ophthalmol* 2008;246(2):181-186.