Outcomes of retained intraocular foreign body removal by pars plana vitrectomy

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Running Title: Outcomes of retained intraocular foreign body removal by pars plana vitrectomy.

Abstract

Propose: To outline the outcome of intra ocular foreign body removal by pars plana vitrectomy.

Patients and Methods: Case series prospective interventional study that was conducted on 34 patients who underwent pars plana vitrectomy for IOFB removal during the period from November 2019 to October 2020, and attending to the outpatient and emergency unit of Mansoura Ophthalmic Center, Mansoura University. The patients were examined then scheduled for PPV for intraoperative removal of IOFB.

Results: The mean age of the studied patients was 34.94±10.946 years. The majority of patients (94.1%) were males. Most of the studied patients were at occupational exposure (73.5%), most of IOFBs in the studied patients were metallic (64.7%), while 35.3% were non-metallic. The mean value of initial BCVA was 0.05±0.081 that improved at 1 week after operation to the mean value of 0.13±0.121, and then continue to improve in the follow-up visits to 0.16±0.156 in the 2nd visit after 3 weeks, 0.19±0.176 in the 3rd visit after 8 weeks and 0.24±0.223 in the 4th visit after 12 weeks. There were 2 cases of raised IOP (5.9%), one case ended with macular scar (2.9%), corneal edema was persistent in one case (2.9%), and Proliferative vitreoretinopathy was noted in 5 cases (14.7%).

Conclusion: IOFB removal by PPV through anterior segment technique was effective, safe, with minimal complications as well as better visual outcome. Improvement of the final BCVA can be successfully predicted by foreign body size, impaction site, initial visual acuity, afferent pupillary defect, and Ocular trauma score.

Keywords: Intra-ocular foreign body, pars plana vitrectomy, eye trauma.

INTRODUCTION

Intraocular foreign bodies have been found to be present in up to 40% cases with ocular trauma[1]. The presence of intraocular foreign body can further be complicated by the development of retinal detachment, uveitis or the most dreaded of all, endophthalmitis[2,3]. Most patients in underdeveloped countries suffer from open-globe trauma, which can cause substantial vision loss. To ascertain the timing of damage, the mechanism of injury, and the nature of the predicted intraocular foreign body, a thorough history is required[4]. Grinding, hammering, metal cutting, machine yard work, and explosive exposure are all high-risk procedures for intraocular foreign bodies[1].

It has been shown by many studies that open globe injury associated with posterior segment intraocular foreign body have a poor visual outcome than open globe injury without intraocular foreign body[5].

Imaging is a very important part of the workup of a patient with an open globe injury. Computed tomography scans are fast, widely available, and effective at detecting a wide range of foreign bodies[6]. Although computed tomography is able to detect most intraocular foreign bodies well, wood intraocular

foreign bodies are usually hypodense and may be mistaken for air or fat[7].

Many studies have demonstrated that standard three port pars plana vitrectomy is an effective method for removal of intraocular foreign body[5]. Advent of small gauge vitrectomy has led to improved visual and anatomical outcomes over the past decade[8]. Because the foreign body might induce endophthalmitis or produce ocular siderosis and chalcosis due to its metal characteristics, the intraocular foreign body has a bad prognosis[5,8]. So, the aim of this study was to describe the outcomes in cases of retained intraocular foreign body after removal by pars plana vitrectomy.

PATIENTS AND METHODS

A prospective case series interventional study done at Mansoura Ophthalmic Center, faculty of medicine, Mansoura University. The study obtained ethical approval of local ophthalmology department research committee as well as Mansoura university IRB committee (IRB code Ms.19.12.956). The study included patients of any age and both genders who had a magnetic or a non-magnetic intraocular foreign body. Patients with history of optic nerve atrophy, history of progressive posterior segment pathology as macular scar and abnormalities that affected vision permanently were excluded. Patients' history was documented with special reference to occupation, time of injury period from entry to management of the foreign body, cause of trauma, type of intraocular foreign body, any medical history of diseases and any past history of ocular trauma, ocular pathology and/or ocular surgery.

Snellen chart was used to determine initial visual acuity, which was then converted to a LogMAR value. The anterior region was assessed using slit lamp examination (Haag Streit BP 900) (Haag-Streit,Koeniz,Switzerland) for the site of IOFB entry and any signs associated with trauma. Fundus was examined by slit lamp biomicroscopy using 90 D Volk lens, direct and indirect ophthalmoscope for site of IOFB impaction, retinal detachment, vitreous haemorrhage and vitritis. Pupillary examination for shape, size, regularity, and reactivity was done. We calculated ocular trauma score **(9)** for all patients.

Initial visual factor

Initial visual factor	**Raw points**
A. Initial visual acuity category	**NLP=60**
	LP to HM=70
	1/200 to 19/200=80
	20/200 to 20/50=90
	≥20/40=100
B. Globe rupture	**-23**
C. Endophthalmitis	**-17**
D. Perforating injury	**-14**
E. Retinal detachment	**-11**
F. Afferent pupillary defect	**-10**

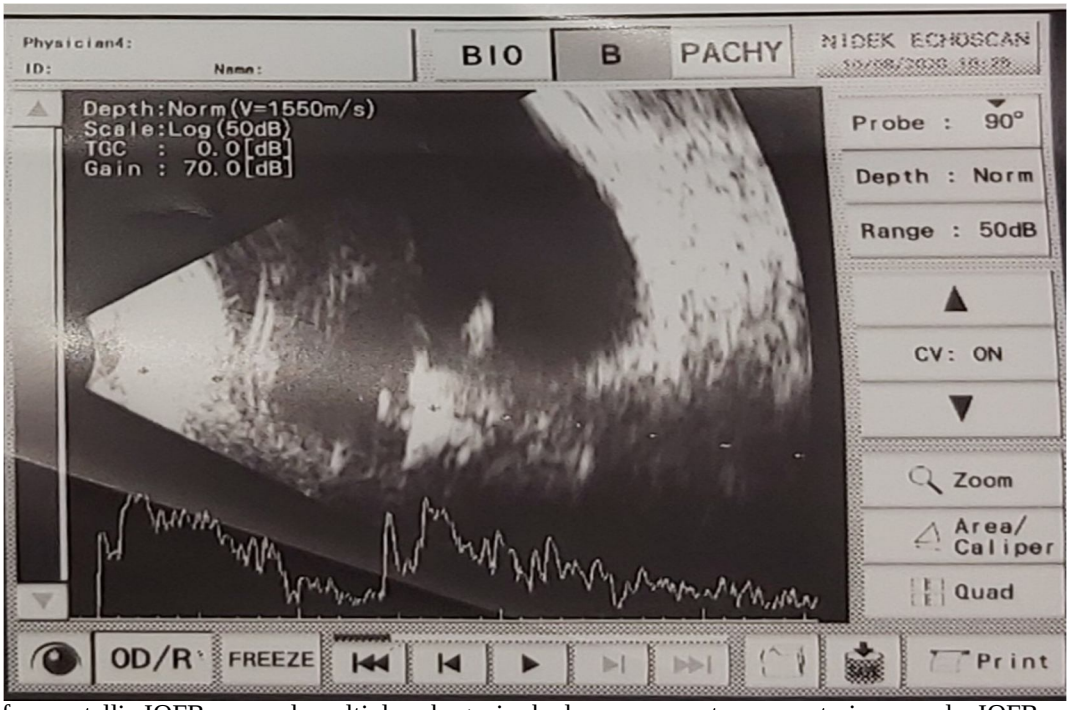
Probability of visual outcome

Raw score sum	**OTS category**	**NLP (%)**	**LP/HM (%)**	**1/200-19/200 (%)**	**20/200-20/50 (%)**	**≥20/ 40 (%)**
0-44	1	73	17	7	2	1
45-65	2	28	26	18	13	15
66-80	3	2	11	15	28	44
81-91	4	1	2	2	21	74
92-100	5	0	1	2	5	92

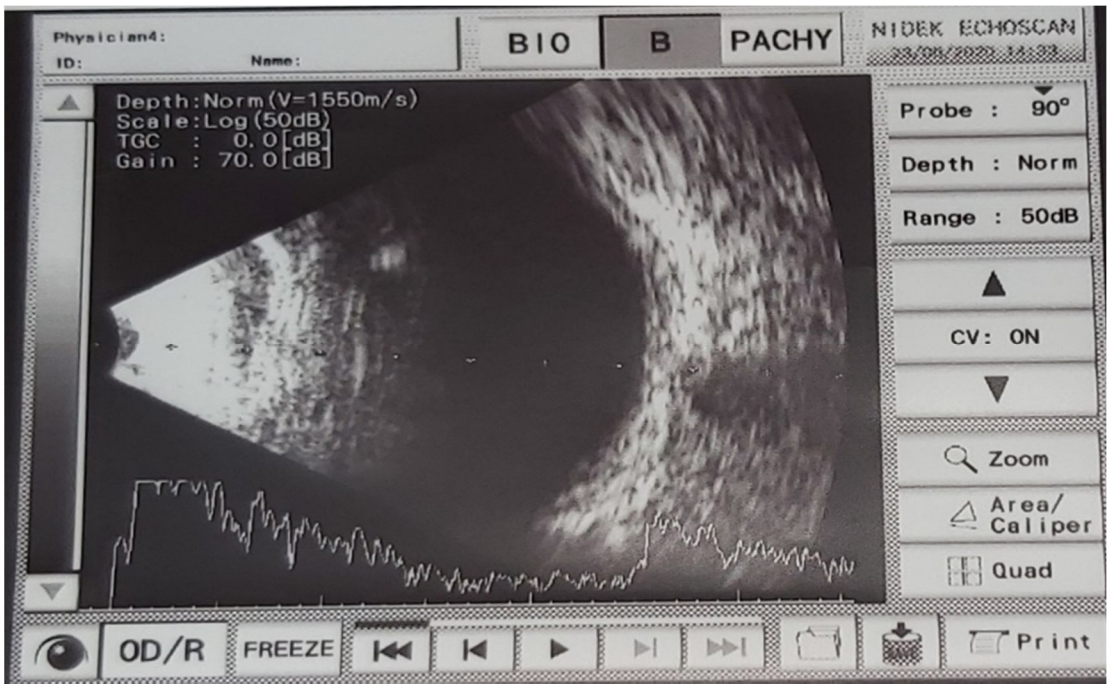
OTS: ocular trauma score/NLP: no light perception/LP: light perception/HM: hand movement

Ultrasonographic evaluation of eye before removal of the intraocular foreign body to detect presence of vitreous hemorrhage, retinal detachment, opened posterior capsule, site of intraocular foreign body

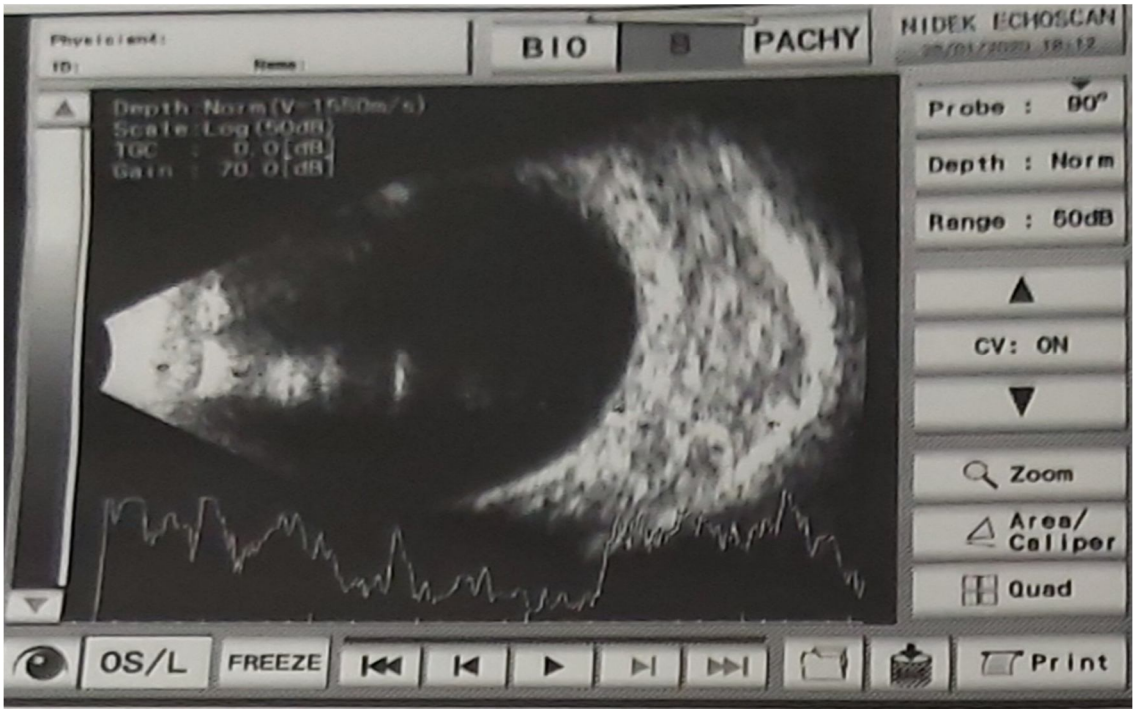
U/S B scan before and after procedure



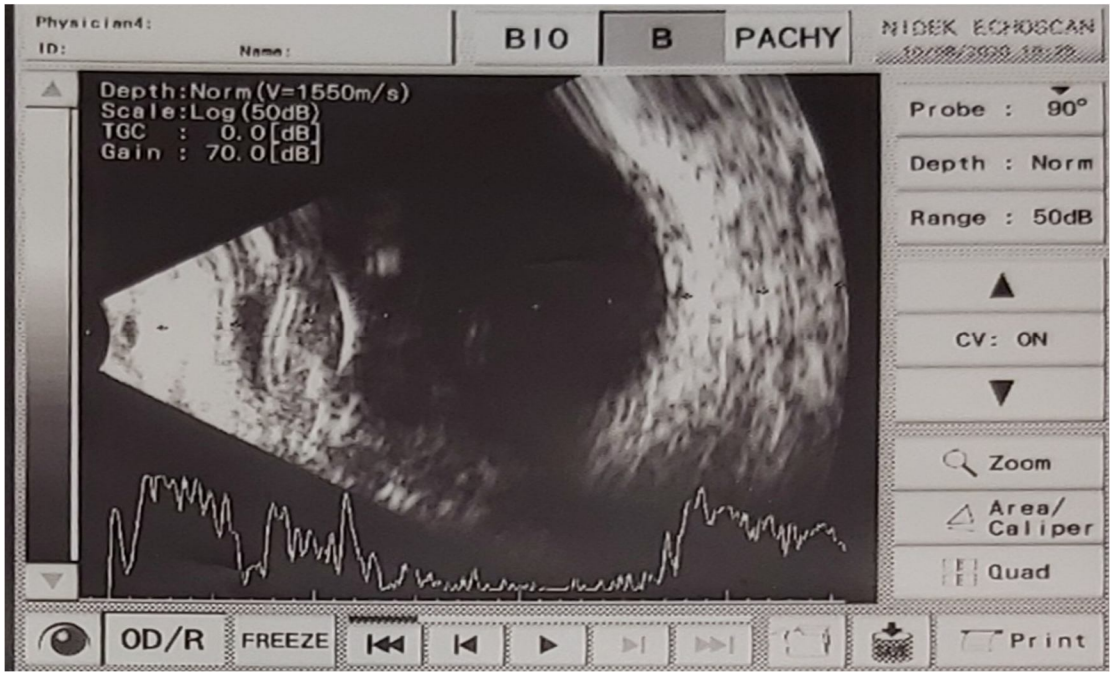
Case 1 Before metallic IOFB removal, multiple echogenic shadows represent open posterior capsule, IOFB and vitreous hemorrhage.



Case 1 After metallic IOFB removal by PPV.



Case 2 Before IOFB removal, echogenic shadows represent IOFB, open posterior capsule, retina in place.



case 2 After IOFB removal by PPV.

Computed tomography orbit was done to the patients to ensure presence, type, and location of intraocular foreign body using (CT-OPTIMA ME, RA, CT, OP.1).

Intervention

The study group with intraocular foreign bodies underwent phacoemulsification for traumatic cataract without IOL implantation with refined posterior capsulotomy. Following that, a pars plana vitrectomy was done under general

or local anesthetic. The conjunctiva was moved by applying a certain level of pressure to the sclerotomy sites. The inferotemporal, superotemporal, and superonasal quadrants were cannulated. Trocars were used to implant the cannulas. At the inferotemporal region, a 23-G infusion cannula was inserted. The posterior segment was seen using a noncontact indirect viewing technique (RESIGHT VIEWING SYSTEM FROM ZEISS). TEBA's 3-port, 23-gauge vitrectomy device was used for all surgical operations (megaTRONS4, GEUDER). The vitrectomy was done from the vitreous base to the posterior vitreous. The hyaloid in the back was separated. The foreign body was introduced into the anterior chamber and removed with magnet or three gripping arms foreign body forceps (VR-1021-29807) through corneal tunnel.

Follow up

First follow up after one week then two weeks then every month for two months. During the period of follow up sutures of primary wound repair were removed. On each follow-up visit detailed examination was performed which included

1.uncorrected visual acuity using snellen chart.

2.Subjective and objective refraction were done to determine the best corrected visual acuity.

3.IOP measurement using schiotz.

4.Anterior segment using slit lamp microscopy

5.posterior segment was examined using 90D volk lens on slit lamp or indirect microscope using 20D volk lens or direct microscope to see complications postoperatively.

6.Ultrasonography B scan and fundus photo were done postoperatively to evaluate any complications as PVR and retinal.

Data analysis

For statistical analysis of the obtained data, IBM's SPSS statistics for windows (Statistical Package for the Social Sciences) version 26 (IBM, Armonk, NY, USA) was utilized. The Shapiro-Wilk test was done to ensure that the data distribution was normal. All tests, such as the samples T test and the Wilcoxon matched pairs signed ranks test, have a 95% confidence interval.

RESULTS

This study included 34 patients with mean age was 34.94 ± 10.95 years. The majority of patients (94.1%) were males, while only 5.9% were females. Most of the studied patients were at occupational exposure (73.5%). Regarding history of ocular pathology, 5.9% of the studied patients had history of diabetic retinopathy, while 2.9% had history of glaucoma (table 1).

Table (1): Demographic characteristics and history of ocular pathology in the studied sample

All patients (n= 34)		Mean & SD	Median	Range	IQR
Age (years)		34.94 ± 10.946	34.50	11.00, 53.00	27.00, 43.50
Gender	**Male**	94.1% (32)			
	Female	5.9% (2)			
Occupation	**Employee**	17.6% (6)			
	Unemployed	8.8% (3)			
	At occupational exposure	73.5% (25)			
History of ocular pathology	**Glaucoma**	2.9% (1)			
	DR	5.9% (2)			

The mean value of the initial visual acuity of the studied patients was 0.05 ± 0.081. Globe rupture and perforating ocular injury were associated in all the studied patients, while 26.5% of patients were associated with afferent pupillary defect, 20.6% had retinal detachment, and only 8.8% were associated with marked vitritis that may be considered as endophthalmitis according to OTS (table 2).

Table (2): Initial visual acuity and associated injuries in the current study.

All patients (n= 34)	Mean & SD	Median	Range	IQR
Initial visual acuity	0.05 ± 0.081	0.01	0.01, 0.29	0.01, 0.05
Globe rupture	100.0% (34)			
Marked vitritis (endophthalmitis)	8.8% (3)			
Perforating injury	100.0% (34)			
Retinal detachment	20.6% (7)			
Afferent pupillary defect	26.5% (9)			

The mean interval between ocular injury and operation was 11.94 ± 6.494 days. The mean size of foreign body was 3.31 ± 0.880 mm. The majority of foreign bodies were metallic (64.7%), while 35.3% were non-metallic. Most of the studied foreign bodies were located in the vitreous (50.0%), 32.4% were on the retina, 8.8% were related to the optic disc, while 8.8% were lenticular. The cornea was the major site of foreign body entry (88.2%), followed by the sclera (11.8%) (table 3).

Table (3): Foreign body characteristics in the current study.

All patients (n= 34)		Mean & SD	Median	Range	IQR
Time between injury and operation (day)		11.94 ± 6.494	10.00	5.00, 38.00	8.00, 13.00
Size of foreign body (mm)		3.31 ± 0.880	3.40	1.90, 5.10	2.50, 4.03
Foreign body types	**Metallic**	64.7% (22)			
	Non-metallic	35.3% (12)			
Location of foreign body	**Lenticular**	8.8% (3)			
	Disc	8.8% (3)			
	Retina	32.4% (11)			
	Vitreous	50.0% (17)			
Site of FB entry	**Cornea**	88.2% (30)			
	Sclera	11.8% (4)			

Data is expressed as mean and standard deviation, median, range and interquartile range or as percentage and frequency.

The mean OTS was 33.97 ± 14.398. The majority of patients (79.4%) were classified as ocular trauma grade (1), while 20.6% were classified as ocular trauma grade (2) (table 4)

Table (4): Ocular Trauma Score (OTS) in the studied patients.

All patients (n= 34)		Mean & SD	Median	Range	IQR
Ocular Trauma Raw Score Sum		33.97 ± 14.398	33.00	6.00, 53.00	22.75, 43.00
Ocular Trauma score categotry	**1**	79.4% (27)			
	2	20.6% (7)			

In the 1st visit at one week after operation , the mean value of BCVA improved to 0.13 ± 0.121, and then continue to improve in the follow-up visits to 0.16 ± 0.156 in the 2nd visit at 3 weeks , 0.19 ± 0.176 in the 3rd visit at 8 weeks , and 0.24 ± 0.223 in the 4th visit at 12 weeks. Accordingly, there were statistically significant differences between the mean value of BCVA in the 1st visit and these in the 2nd, 3rd, and 4th follow-up visits ($p<0.05$**)** (table 5).

Table (5): BCVA follow-up in the current study

BCVA	Mean & SD	Median	Range	IQR	95% CI	p
First visit	0.13 ± 0.121	0.09	0.0, 0.40	0.04, 0.20	-	-
Second visit	0.16 ± 0.156	0.10	0.005, 0.50	0.02, 0.29	- 0.06, - 0.01	**0.006**
Third visit	0.19 ± 0.176	0.10	0.0, 0.67	0.02, 0.29	-0.10, -0.03	**0.001**
Fourth visit	0.24 ± 0.223	0.10	0.0, 0.67	0.02, 0.50	-0.16, -0.06	**< 0.001**

The most commonly associated complication was PVR in 14.7% of patients. Other related complications included raised IOP, macular scar, and corneal edema (table 6).

There were statistically significant and positive correlations between BCVA and each of Ocular Trauma Row Score, site of foreign body in the vitreous cavity, and initial visual acuity ($p<0.001$); while statistically significant and negative correlations between BCVA and size of foreign body ($p<0.05$) (table 7). Statistically significant and negative correlation was found between PVR and Ocular Trauma Row Score, ($p<0.05$); while positive correlations were found between PVR and each of lenticular and retinal foreign body impaction (table 8).

Table (6): Incidence of complications in the current study.

		All patients (n= 34)
First visit	**Raised IOP**	5.9% (2)
	Macular scar	2.9% (1)
	PVR	14.7% (5)
Second visit	**Raised IOP**	5.9% (2)
	Macular scar	2.9% (1)
	PVR	14.7% (5)
Third visit	**Raised IOP**	5.9% (2)
	Macular scar	2.9% (1)
	Corneal edema	2.9% (1)
	PVR	14.7% (5)
Fourth visit	**Raised IOP**	5.9% (2)
	Macular scar	2.9% (1)
	Corneal edema	2.9% (1)
	PVR	14.7% (5)

Table (7): Correlation between BCVA and other studied parameters.

BCVA	Correlation coefficient	p
Pathology	0.098	0.583
Ocular Trauma Row Score	0.715	**< 0.001**
Size of foreign body (mm)	-0.397	**0.020**
Non-metallic foreign body	0.204	0.247
Lenticular foreign body	-0.267	0.127
Disc foreign body	-0.219	0.212
Retina foreign body	-0.314	0.070
Vitreous foreign body	0.570	**< 0.001**
Time between entry and operation	-0.288	0.099
Initial visual acuity	0.593	**< 0.001**

Table (8): Correlation between occurrence of PVR and other studied parameters.

PVR	Correlation coefficient/ Odds ratio	p
Pathology	0.84	-
Ocular Trauma Row Score	-0.468	**0.005**
Size of foreign body (mm)	0.092	0.607
Non-metallic foreign body	0.41	-
Lenticular foreign body	**3.38**	-
Disc foreign body	0.84	-
Retina foreign body	**3.94**	-
Vitreous foreign body	0.20	-
Time between entry and operation	0.276	0.114
Initial visual acuity	-0.211	0.232

Discussion

Visual morbidity and blindness are common in the working population due to ocular trauma. Any aberrant material or item that does not belong in the eye is referred to as a foreign body. The prevalence of foreign bodies in the eye is substantial, particularly in industrialized areas. All ages and in both genders are susceptible[10].

The advancement of vitreo-retinal surgical procedures and technology has enabled the treatment of these difficult patients to be optimized[11].

Most patients in underdeveloped nations suffer from open-globe damage, which can result in catastrophic vision loss[12]. Several studies have demonstrated that open globe injuries associated with posterior segment IOFBs have a poor visual outcome than open globe injuries without IOFBs. Small metallic IOFBs can be removed with intraocular earth magnets, while non-metallic IOFBs and metallic IOFBs bigger than 3 mm require specialized gripping forceps[5].

A number of studies have shown that the standard three port pars plana vitrectomy is an effective method for removal of IOFBs. In addition, advent of small gauge vitrectomy has led to improved visual and anatomical outcomes over the past decade[13]. However, one of the most serious complications of IOFB removal is retinal break, causing retinal detachment, as well as post-traumatic proliferative vitreo-retinopathy (PVR)[14]. The current study was conducted to describe the outcomes in cases of retained IOFB after removal by pars plana vitrectomy.

The present study is a prospective case series interventional study that was conducted on 34 patients with magnetic or non-magnetic IOFB, who underwent pars plana vitrectomy.

There are a number of characteristics that have been discovered to have a strong correlation with visual result, including age[15,16], injury type or mechanism[17,18], Baseline VA[13,19,20,21], presence of relative afferent pupillary defect (RAPD)[16,18], extent of wound and size of open-globe injury[16, 22], location of open globe wound[23, 24], lens damage[16, 25], hyphema[16,17,18], vitreous hemorrhage[16, 17], retinal detachment (RD)[16, 18], and presence and type of IOFB[26].

In terms of demographic features, the average age of the patients was 34.94 ± 10.946 years. Male patients were (94.1%) Most of the studied patients were at occupational exposure (73.5%).

The present work demonstrated that the mean interval between ocular injury and IOFB removal was 11.94 ± 6.494 days (ranged from 5 to 38 days). The mean value of the initial visual acuity of the studied patients was 0.05 ± 0.081. Globe rupture and perforating ocular injury were associated in all the studied patients, while 26.5% of patients were associated with afferent pupillary defect, 20.6% had retinal detachment (RD), and only 8.8% were associated with marked vitritis. The current results showed that the majority of IOFBs in the studied patients were metallic (64.7%), while 35.3% were non-metallic. Most of the studied foreign bodies were located in the vitreous (50.0%), 32.4% were on the retina, 8.8% were related to the optic disc, while 8.8% were lenticular. The cornea was the major site of foreign body entry (88.2%), followed by the sclera (11.8%).

Dhoble and Khodifad (2018) completed a research to explain the outcomes of combined cataract extraction with pars plana vitrectomy and metallic IOFB removal through a sclero-corneal tunnel utilizing the "magnetic handshake" approach, which agrees with the present findings. The average age of the patients in that research was 33.04 11.68 years. The average time between injury and presentation was 3.75 2.86 days, with a median of 12 months. The follow-up period varied from 4 to 48 months. In the research, the average IOFB size was 4.42 2.56 mm (range, 1 mm to 9 mm). Only one patient had a scleral entry site, whereas 13 (92.85%) had a corneal entry site[13].

In most population-based studies Maneschg et, al., (2011), Chow et, al., (2000), Loon et, al., (2009) males are more likely than females to sustain open globe injuries. Similarly, there was a considerable male majority in the current investigation. This might be due to men's more aggressive tendencies and, to a lesser extent, their participation in higher-risk employment activities[21,27,28].

Furthermore, in the current study, the majority of patients were under the age of 40, which is consistent with past research as Agrawal et, al., (2011), Loon et, al., (2009),Wong TY, Tielsch JM(1999)[16, 28, 29].

The presence of a RAPD and vitreous loss were statistically significant in predicting outcome of all clinical indications at presentation following injury. As demonstrated in earlier trials by Agrawal et, al., (2011), Man CYW, Steel D. (2010), Loon et, al., (2009), if RAPD was present, the resultant eyesight result was much poorer[16,18,28].

In the study by Rahman et al. (2006)[30], Enucleation was performed on 48 percent of RAPD patients.. Similarly, in the study by Pieramici et al. (2003)[31], If a RAPD was present at the time of presentation, 55 percent of the eyes were enucleated, compared to just 7% in the absence of a RAPD. Furthermore, the presence of RAPD increased the likelihood of a final VA of counting fingers (CF) or worse by a factor of 10.in the study by Rofail et al. (2006)[32]. Hence, In both the current investigation and the previous literature, RAPD has been established as an important predictor of visual result.

The occurrence of vitreous loss was shown to be a poor prognostic predictor in research done by Isaac et al. (2003). The end visual result was worse than HM in more than 65 percent of individuals with vitreous loss. The presence of vitreous loss indicates that there is also vitreo-retinal injury and potentially retinal trauma present[33].

The Ocular Trauma Score (OTS) was created by Kuhn et al. (2002) to predict the visual prognosis of individuals after ocular trauma. To find these predictors, the authors looked at over 2500 eye injuries from the US and Hungarian Eye Injury Registries and examined over 100 factors. OTS is similar to the APGAR score used in obstetrics. Patients with an OTS score of one are more likely to have a bad final visual outcome than those with an OTS score of five, who are more likely to have a better final vision outcome[34].

We attempted to compare and stratify the research subjects in the current study using the same scoring technique, and the study score in our series was extremely similar to the worldwide OTS system. Han and Yu (2010) recorded the final VA evaluation utilizing OTS categories to be equivalent to USEIR OTS in another series from Asia. It implies that OTS may be useful in predicting open globe injuries in Asians[19].

CONCLUSION

IOFB removal by PPV through anterior segment technique was effective, safe, with minimal complications as well as better visual outcome. The final visual prognosis is influenced by the initial visual acuity following trauma, the mechanism of damage, the existence of RAPD, the posterior extent of the lesion, and the presence of severe vitreous loss. The Ocular Trauma Score (OTS) is a highly thorough score for predicting the eventual visual prognosis in patients with open globe injury, and it should be utilized more widely by ophthalmologists worldwide for trauma victim counseling.

DATA AVAILABILITY

All data are included in this article.

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None

Conflict of Interest

Authors declare no conflicts of interest.

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Ethics declarations

Conflict of interest

Alaa S. Awad, Sherif E. ELkholy, Amr M. ElSayed, Sahar M. EL-Tarshouby. all authors have no conflicts of interest that are directly relevant to the content of this review.

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