Evaluation of surgical success and outcomes of patients who underwent pars plana vitrectomy due to intraocular foreign body injuries

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BACKGROUND

Penetrating ocular injury with an associated retained intraocular foreign body (IOFB) is a significant cause of blindness and ocular morbidity. It occurs in 17% to 41% of open globe injuries (1-2). In addition to the initial injury, ocular abnormalities resulting from surgical procedures and postoperative complications can adversely affect visual outcomes (3-5). Advancements in vitreo-retinal surgery techniques and instrumentation have enabled more effective management of complex cases (6). Previous studies have reported outcomes of pars plana vitrectomy for the removal of posterior segment IOFBs (7,8). The goal in managing an IOFB is to achieve the best visual outcome possible by identifying and closing the entry and exit sites, reconstructing the eye and if possible, removing the object. The aim of this study was to assess the morpho-functional outcomes and safety of transconjunctival pars plana vitrectomy (PPV) for removing IOFBs.

MATERIALS AND METHODS

Patients and study design

This retrospective study included 21 eyes of 21 patients who underwent transconjunctival PPV for the removal of IOFBs at Basaksehir Cam Sakura City Hospital in Istanbul, Turkey between May 2020 and January 2024. Written informed consent was obtained from all subjects prior to surgery. The study adhered to the principles outlined in the Declaration of Helsinki and received approval from the local ethics committee. Age, gender, type of accident, initial and final best corrected visual acuity (BCVA), time of initial injury, characteristics of the IOFB, data of primary repair and initial ocular findings, were evaluated preoperatively. And also to confirm and localize the IOFB, B mode ultrasonography and computer tomography were used. The entry wound locations were classified according to the Ocular Trauma Classification Group and categorized into three zones (9). The time of surgical intervention was specified as early (<48 hours) and late (>48 hours). We utilized the Ocular Trauma Score (OTS), a simplified categorical system, to assess visual prognosis in cases of ocular injuries. The BCVA was converted to the logarithm of the minimal resolution angle (LogMAR) scale for statistical analysis. Patients were observed for a mean period of 1 year following surgery. In our study, anatomical and functional success was defined by setting some criteria. Anatomical success was defined in cases with reattachment of the retina and reattachment of the retina with gas tamponade at the last visit after removal of silicone oil, and cases that did not result in phthisis at the last visit and reattachment of the retina with gas tamponade, and cases that did not result in phthisis at the last visit. Functional success was defined as patients with the best corrected visual acuity of 0.05 or higher after one

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year of postoperative follow-up.

Surgical intervention

As a surgical method, PPV and IOFB removal using an intraocular forceps with scleral or limbal approach was applied. Surgical data included the location of the removed foreign body, lens surgery, and the type of tamponade used. During surgical procedures, the condition of the retina and the location of IOFBs were meticulously documented. In addition, retinal detachment (RD), the presence of proliferative vitreoretinopathy (PVR), and the number of additional surgeries performed during the follow-up period were detected. Additional surgical procedures were performed based on the specific situation, including lens extraction (via the anterior chamber or pars plana), intraocular lens (IOL) implantation, and repair of retinal breaks or detachments.

Stastistical analysis

The statistical analyses were conducted using IBM SPSS Statistics (Version 28). Descriptive statistics for continuous variables included mean ± standard deviation and median (range), while categorical variables were summarized using counts and percentages. Pre- and postoperative visual acuity were compared using the Wilcoxon signed ranks test. Relationships between continuous variables were explored using Spearman correlation coefficients. A significance level of 95% was applied, and results with p-values less than 0.05 were considered statistically significant.

RESULTS

Twenty-one eyes of 21 patients were included in the study. The ages of the patients ranged from 15 to 63 years (mean ± SD, 39.5 ± 14.7). All of the patients included in the study were male and 57.1% of them underwent surgery on their right eye. Although the type of injury was in the form of penetrating trauma in all patients, early (<48 hours) intervention was performed in 47.6% of the patients (table 2). Intraocular foreign bodies were metallic in 18 (85.7%), stone in 2 (9.5%), and glass in 1 (4.8%) cases (table 2). The extracted IOFB size ranged from 1 to 13 mm (3.52 ± 3.04). The most common site of IOFB was the macula 9 (43.0%) of the cases, and the most common accompanying finding was cataract 14 (66.7%) of the cases. Associated other findings were endophthalmitis in 1 (4.8%) and retinal detachment in 1 (4.8%) of the cases (table 2). In 13 patients (61.9%), IOFB was removed using a scleral approach, while in 8 patients (38.1%), limbal approach was applied for removal (table 2). As endo-tamponade, perfluoropropane (C3F8) was injected in 8 (38.1 %) patients, silicone oil was injected in 5 (23.8%) patients, and air to 5 patients (23.8%). While two patient were injected with sulfur hexafluoride (SF6), one patient was given heavy silicone oil (table 2). Silicone oil was successfully removed during the 1-year follow-up period from all patients who received silicone oil during surgery. Combined surgery was performed in 16 (76.0%) patients. 14 (66.7%) patients underwent only cataracts and IOFB extraction, 1 patient (4.8%) underwent combined cataract and retinal detachment (RD) and 1 (4.8%) patient underwent combined cataract and macular hole surgery. At the time of initial presentation, cataract had not developed in 5 patients, but it was observed to develop in 3 of them during the follow-up period. Lens extraction and intraocular lens implantation were performed in these patients at a later time. None of the patients developed proliferative vitreoretinopathy after surgery. Mean preoperative LogMAR BCVA was 2.19 ± 1.09 (range, 3.00 to 0.22) and mean postoperative LogMAR BCVA at final visit was 1.03 ± 0.90 (range, 1.00 to 0.15) (table 1). 18 patients (85.7%) final visual acuity were better than preoperative values. As a result the increase in postoperative visual acuity was found to be statistically significant ($p< 0.0001$). Furthermore, it was observed that patients with delayed surgical intervention had lower visual acuity (higher LogMAR), however, this difference was not statistically significant ($p>0.05$). Ocular trauma score (OTS) was calculated as 1 in 2 patients (9.5%), 2 in 14 patients (66.7%), 3 in 3 patients (14.3%) and 4 in 2 patients (9.5%) (table 2). There is a statistically significant negative correlation between the Ocular Trauma Score (OTS) and both preoperative visual acuity ($r = -0.743$, $p < 0.001$) and postoperative visual acuity ($r = -0.608$, $p = 0.003$) ($p<0.005$) (table 3).

Table 1. *Baseline and Postoperative Visual Acuity*

	Mean±SD	Median (IQR)	p
Baseline BCVA (LogMAR)	2.19±1.09	3.00 (0.22-3.00)	<0.001*
Postoperative BCVA (LogMAR)	1.03±0.90	0.82 (0,15-3.00)	

*Wilcoxon signed-rank test, *p<0.05; SD: Standart Deviation, IQR: Interquartile Range*
BCVA, best-corrected visual acuity; LogMAR, logarithm of the minimum angle of resolution

Table 2. *Preoperative and Peroperative Ocular Findings Associated with Intraocular Foreign Bodies*

		n	%
Duration of Surgical Intervention	Early	10	47.6
	Late	11	52.4
IOFB Material	Glass	1	4.8
	Metallic	18	85.7
	Stone	2	9.5
IOFB Localization	Lens	4	19.0
	Macula	9	43.0
	Sclera	4	19.0
	Vitreus	4	19.0
Concomitant Complications	Endophthalmitis	1	4.8
	Cataract	14	66.7
	Corneal Scar	3	14.3
	RD	1	4.8
	Tears	2	9.5
OTS	1	2	9.5
	2	14	66.7
	3	3	14.3
	4	2	9.5
Type of Tamponade	Heavy Silicone	1	4.8
	C3F8	8	38.1
	Air	5	23.8
	SF6	2	9.5
	5000 Cst Silicone	5	23.8
Impacted Zone	1	17	81.0
	2	4	19.0
Combined Surgery	Cataract	14	87.5
	Cataract and RD	1	6.3
	Cataract and Macular Hole	1	6.3
Method of Removal of IOFB	External	13	61.9
	Internal	8	38.1

IOFB, Intraocular foreign body; RD, Retinal detachment; OTS, Ocular trauma score; C3F8, Perfluoropropane; SF6, Sulfurhexafluoride; Cst, centistokes.

Table 3. *Analysis of the Relationship Between Ocular Trauma Score and Visual Acuity*

		r	p	95% CI	
			Lower Limit	Upper Limit	
OTS	Baseline BCVA (LogMAR)	-0.743	<0.001*	-0.892	-0.447
OTS	Postoperative BCVA (LogMAR)	-0.608	0.003*	-0.828	-0.226

r: Spearman's rho, CI: Confidence Interval, *p<0.05
OTS, Ocular trauma score; BCVA, best-corrected visual acuity; LogMAR, logarithm of the minimum angle of resolution

DISCUSSION

In developing countries, IOFBs pose a significant challenge among the young working-age population. These injuries can have severe consequences for vision and require urgent attention (8). Consistent with previous findings, our study revealed that all patients were male, with a mean age of 38 years. Traumatic eye injuries caused by IOFBs can lead to severe tissue damage and significant visual loss, depending on various factors. Factors such as the time between trauma and IOFB extraction, initial visual acuity, entrance of the IOFB location, type of IOFB material, preoperative RD, presence of endophthalmitis, use of lensectomy, type of endotamponade can affect the visual outcome (8,10-12). The goal of treating IOFBs is to restore ocular integrity and achieve visual function. Studies indicate that early PPV after trauma is associated with a favorable prognosis. However, some authors argue that the timing of PPV may not directly impact visual outcomes (8). In our study, 10 of 21 patients received early intervention (<48 hours). Although visual acuity was found to be better in patients who were intervened early, the result was not statistically significant. If all patients had applied earlier, our intervention time could have been earlier. Numerous complications can occur simultaneously with IOFB injury. Complications associated with IOFBs after trauma include traumatic cataract, RD, proliferative vitreoretinopathy, endophthalmitis, hyphema, vitreous hemorrhage, and siderosis. Traumatic cataract associated with IOFBs is a prevalent issue, occurring in approximately 44% to 66% of cases (1). Cataract is the most common accompanying finding also in our study

Table 4. *Pre and Postoperative Correlations Between Ocular Trauma Score, Visual Acuity and Intraocular Foreign Body Dimension*

		r	p	95% CI	
			Lower Limit	Upper Limit	
OTS	Baseline BCVA (LogMAR)	-0,743	<0,001*	-0,892	-0,447
OTS	Postoperative BCVA (LogMAR)	-0,608	0,003*	-0,828	-0,226
OTS	IOFB Dimension	0,040	0,863	-0,410	0,474
Baseline BCVA (LogMAR)	IOFB Dimension	-0,056	0,808	-0,487	0,396
Postoperative BCVA (LogMAR)	IOFB Dimension	-0,030	0,896	-0,467	0,418

r: Spearman's rho, CI: Confidence Interval, *p<0.05
OTS, Ocular trauma score; BCVA, best-corrected visual acuity; LogMAR, logarithm of the minimum angle of resolution, Intraocular Foreign Body Dimension; IOFB

(66.7%). During vitrectomy, lens extraction was done via phacoemulsification or pars plana lensectomy in 16 of 21 cases. Gas (SF6 or C3F8) or silicone oil tamponade injected to stabilize the retina and aid in its healing process at the end of the surgery. Endophthalmitis associated with IOFBs is a critical complication that signifies a poor prognosis. The reported incidence of endophthalmitis varies widely in the literature, ranging from 1.3% to 61% (13-17). A further associated finding in cases of IOFBs is RD which has a significant impact on visual outcomes. The reported incidence of retinal detachment prior to PPV ranges from 15% to 37% (13,15,16). However endophthalmitis was observed in 1 case, and RD was observed in 1 case in our study. It has been known that IOFBs are typically located in the posterior segment, with most commonly being in the vitreous cavity and less often embedded within the retina (13,14). However, in our study, the foreign body was observed in the vitreous in only 4 patients (19%) and was embedded in the macula in 9 (43%) patients. It was observed in the lens and sclera in the remaining patients. Another important prognostic factor is foreign body material. IOFB material was detected as metallic in 18 patients (85.7%). Similar to previous studies, our study revealed that metallic IOFBs were the most common (18-20). In cases of IOFBs, extraction typically occurs either through a corneoscleral limbal incision or directly from the sclera. The choice depends on the size of the IOFB and the condition of the lens. In cases where IOFBs are larger than 6 mm in diameter, they are usually removed from the corneoscleral limbus. For smaller IOFBs, removal can be done from the limbus or sclera. The choice of approach also depends on whether the patient has had a traumatic cataract (21). In our study, IOFBs were removed via the scleral route in 13 patients and the limbal route in 8 patients. However in our study, we found that the mean size of IOFBs was 3.52 ± 3.04 mm when applying PPV for their removal. This information highlights the importance of considering IOFB size during surgical decision-making. While initial visual acuity is another factor determining prognosis, in our study, we calculated the OTS and evaluated its relationship with final visual acuity. Literature suggests that an initial better visual acuity is predictive of a more favorable visual outcome (2,13,20,22). As a result, our findings revealed a statistically significant correlation between the OTS and final visual acuity (p<0.05). Our study had some limitations such as small number of patients and short follow-up time. In addition, the uneven distribution of IOFB material diversity constitutes a statistical limitation.

CONCLUSIONS

We identified just only one factor that was significantly associated with a better visual outcome in our series which was ocular trauma score. In our study, similar to the literature, traumatic cataract was the most common complication associated with IOFB. Although it was shown that the visual outcome was better in patients with early

intervention in our study, a statistical comparison could not be made due to the small number of patients. In conclusion, PPV is an important option in the management of patients with IOFB, but the complications accompanying the trauma and the duration of intervention are also important in terms of visual prognosis.

REFERENCES

1. Gaudio AR. Intraocular foreign bodies. In: Albert DM, Jacobiec FA, eds. Principles and Practice of Ophthalmology. Philadelphia: WB Saunders Company; 2000:2514–2530.
2. Zhang Y, Zhang M, Jiang C, Qiu HY. Intraocular foreign bodies in china: clinical characteristics, prognostic factors, and visual outcomes in 1,421 eyes. Am J Ophthalmol. 2011;152:66–73.
3. Peyman GA, Raichand M, Goldberg MF, Brown S. Vitrectomy in the management of intraocular foreign bodies and their complications. Br J Ophthalmol. 1980;64:476–82.
4. Alfaro DV, Roth D, Liggett PE. Posttraumatic endophthalmitis. Causative organisms, treatment, and prevention. Retina. 1994;14:206–11.
5. Chaudhry IA, Shamsi FA, Al-Harthi E, Al-Theeb A, Elzaridi E, Riley FC. Incidence and visual outcome of endophthalmitis associated with intraocular foreign bodies. Graefes Arch Clin. 2008;246:181–6.
6. Mittra RA, Mieler WF. Controversies in the Management of Open-Globe Injuries Involving the Posterior Segment. Surv Ophthalmol. 1999;44:215–25.
7. El-Asrar AM, Al-Amro SA, Khan NM, Kangave D. Visual outcome and prognostic factors after vitrectomy for posterior segment foreign bodies. Eur J Ophthalmol. 2000;10:304–11.
8. Jonas JB, Knorr HLJ, Budde WM. Prognostic factors in ocular injuries caused by intraocular or retrobulbar foreign bodies. Ophthalmology. 2000;107:823–8.
9. Kuhn, F. et al. The ocular trauma score (OTS). Ophthalmol. Clin. N. Am. 15(163–165), vi. https:// doi. org/ 10. 1016/ s0896- 1549(02) 00007-x (2002).
10. Kuhn F, Morris R. Posterior segment intraocular foreign body management in the vitrectomy. Ophthalmology. 2000;107:821–822.
11. Ahmedieh H, Sajjadi H, Azarmina M, Soheilian M, Baharivand N. Surgical management of intraretinal foreign bodies. Retina. 1994; 14:397–403.
12. Aras C, Ozdamar A, Yıldırım R, Oncel M, Bahcecioglu H, Karacorlu M. Long term prognosis of intraocular foreign body removal. Turk J Ophthalmol. 1999;29:260–263.
13. Greven CM, Engelbrecht NE, Slusher MM, Nagy SS. Intraocular foreign bodies: management, prognostic factors, and visual outcomes. Ophthalmology. 2000;107:608–617.
14. Williams DF, Mieler WF, Abrams GW, Lewis H. Results and prognostic factors in penetrating ocular injuries with retained intraocular foreign bodies. Ophthalmology. 1988;95:911–916.
15. Kazokoglu H, Saatci O. Intraocular foreign bodies: results of 27 cases. Ann Ophthalmol. 1990;22:373–376.
16. Karaman M, Ozgun C, Yıldırım A, Ongor E. Pars plana vitrectomy in foreign bodies in globe. Turk J Ophthalmol. 1995;25:348–351.
17. Thompson JT, Parver LM, Enger CL, Mieler WF, Liggett PE. Infectious endophthalmitis after penetrating injuries with retained intraocular foreign bodies. Ophthalmology. 1993;100:1468–1474.
18. Woodcock MG, Scott RA, Huntbach J, et al. Mass and shape as factors in intraocular foreign body injuries. Ophthalmology. 2006;113(12):2262–9.
19. Demircan N, Soylu M, Yagmur M, et al. Pars plana vitrectomy in ocular injury with intraocular foreign body. J Trauma. 2005;59(5):1216–8.
20. Ehlers J, Kunimoto D, Ittoop S, et al. Metallic intraocular foreign bodies: characteristics, interventions, and prognostic factors for visual outcome and globe survival. Am J Ophthalmol. 2008;146(3):427–33.
21. Ma J, Wang Y, Zhang L, Chen M, Ai J, Fang X. Clinical characteristics and prognostic factors of posterior segment intraocular foreign body in a tertiary hospital. BMC Ophthalmol. 2019 Jan 14;19(1):17. doi: 10.1186/s12886-018-1026-5.
22. Chiquet C, Zech J, Denis P, Adelin P, Trepsat C. Intraocular foreign bodies. Factors influencing final visual outcome. Acta Ophthalmol Scand. 1999;77:321–5.