ORIGINAL ARTICLE

Prophylactic chorioretinectomy in deadly weapon-related open globe injuries

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ABSTRACT

BACKGROUND: To evaluate the anatomical and functional outcomes of pars plana vitrectomy (PPV) combined with prophylactic chorioretinectomy (CR) in patients with deadly weapon-related open globe injuries (DWOGIs).

METHODS: Medical records of patients who underwent PPV and prophylactic CR for open globe injuries (OGIs) caused by deadly weapons between November 2016 and October 2024 were retrospectively reviewed. Demographic characteristics, injury type, cause of injury, zone of injury, intraocular foreign body (IOFB) exit/impact site, best-corrected visual acuity (BCVA), proliferative vitreoretinopathy (PVR) rates, anatomical success, and globe survival were evaluated.

RESULTS: Of a total of 283 OGIs, 41 eyes from 35 patients who underwent PPV with prophylactic CR for deadly weapon-related trauma were included in the analysis. The mean age was 30.9±9.4 years, and 88.6% of the patients were male. Perforating injuries were observed in 38 eyes (92.7%), and penetrating injuries associated with an IOFB in 3 eyes (7.3%). The causes of injury included improvised explosive devices in 20 eyes (48.8%), hand grenades in 11 eyes (26.8%), landmines in 8 eyes (19.5%), and rocket-propelled grenades in 2 eyes (4.9%). The IOFB exit/impact site was located in the posterior pole in 38 eyes (92.7%), of which 22 (53.6%) were outside the vascular arcades, 12 (29.3%) within the vascular arcades, and 4 (9.7%) adjacent to the optic disc. The mean initial BCVA was 2.62±0.98 logMAR, with 90.2% of eyes presenting between light perception and counting fingers. PPV was performed at a mean of 5.9±2.7 days after primary repair. Of these eyes, 43.9% had retinal detachment. The mean number of PPV procedures was 2.6±1.1. C_3F_8 gas endotamponade was used in 51.2% of cases. At a mean follow-up of 32.8±16.6 months, the final BCVA improved significantly to 1.18±1.20 logMAR ($p<0.001$), with 68.3% achieving ≥20/200 vision. At final follow-up, the rates of PVR, anatomical success, and globe survival were 14.6% (6/41), 85.4% (35/41), and 87.8% (36/41), respectively.

CONCLUSION: Pars plana vitrectomy combined with prophylactic CR appears to be an effective treatment option for DWOGIs, offering prevention of PVR development and achieving high anatomical success, favorable globe survival, and meaningful visual improvement despite severe ocular trauma.

Keywords: Chorioretinectomy; deadly weapon; intraocular foreign body; ocular trauma, open globe injury; penetrating eye injury; perforating eye injury; proliferative vitreoretinopathy.

INTRODUCTION

Open globe injuries (OGIs) are among the leading causes of ocular morbidity and blindness worldwide.[1] Globally, the incidence of OGI is 3.5 per 100,000 individuals per year, corresponding to approximately 203,000 cases annually.[2] The long-term prognosis is largely influenced by the severity of the initial mechanical damage as well as the biological processes of wound healing and scar development. Proliferative vitreoretinopathy (PVR), which develops secondary to scarring in 40-60% of OGIs, remains a major limiting factor for both visual and anatomical rehabilitation.[3-5]

Within the spectrum of OGIs, deadly weapon-related OGIs

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(DWOGIs) represent a particularly severe subset due to the high-velocity nature of ballistic trauma and the extensive structural damage. Firearm injuries involving the face and head are associated with substantial morbidity and mortality.[6] Although research on firearm-associated ocular injury (FAOI) is limited, available data highlight its significant impact on vision.[7,8]. In one of the few studies addressing FAOI, hopra et al.[9] reported that 44% of survivors treated at two New York City hospitals suffered long-term visual disability, underscoring the devastating ocular consequences of firearm trauma. Despite these findings, population-level and mechanism-specific data on FAOI remain scarce, and the true burden of deadly weapon–related ocular trauma is likely underestimated.

Given the high risk of PVR and anatomical failure in severe OGIs, various surgical strategies have been explored to mitigate post-traumatic scarring. In 1987, Zivojnovic first proposed a surgical method aimed at excising incarcerated retinal tissue and associated scar tissue at the site of perforation.[10] Later, in 2004, Kuhn et al.[12] introduced prophylactic chorioretinectomy (CR) for the management of intraocular foreign bodies (IOFBs) that penetrate the globe or for globe ruptures with scleral involvement extending posterior to the extraocular muscle insertions. In this technique, within the first 100 hours following injury, all incarcerated retina at the wound site is removed using a vitrector, and the surrounding retina and choroid at the exit wound are ablated with diathermy along a narrow circumferential zone approximately 1 mm in width of exposed sclera.[11] Early data from an international, prospective, multicenter investigation led by the United States Eye Injury Registry in collaboration with the American Society of Ocular Trauma indicated that CR reduced PVR rates from approximately 60% to below 10%. Subsequent series have consistently reported favorable visual outcomes and similarly low PVR rates in eyes treated with this approach.[13-18]

Despite accumulating evidence supporting the role of prophylactic CR in reducing PVR following severe ocular trauma, data specifically focusing on DWOGIs remain limited. In this study, we aimed to evaluate the anatomical and functional outcomes of prophylactic CR combined with pars plana vitrectomy (PPV) in patients with DWOGI treated at a major tertiary ocular trauma referral center in Türkiye.

MATERIALS AND METHODS

This retrospective study was approved by the local institutional review and ethics board (IRB #2025-617). The study adhered to the principles of the Declaration of Helsinki. Medical records of patients who underwent PPV and prophylactic CR for OGIs caused by deadly weapons between November 2016 and October 2024 were retrospectively reviewed. Patients with missing medical records, those who presented with end-stage ocular conditions that precluded further treatment (e.g., phthisis bulbi), and those with a follow-up period of < 12 months were excluded from the analysis.

All but one of the patients were managed initially at outside centers and were subsequently referred after primary globe repair, including closure of the scleral defect and restoration of globe integrity. Following primary globe repair, all patients underwent orbital computed tomography and B-scan ultrasonography at our clinic. The injuries were categorized according to the Birmingham Eye Trauma Terminology (BETT) classification of ocular trauma.[19] The present study includes only eyes with severe posterior segment involvement considered to be at high risk for PVR and therefore managed with PPV combined with prophylactic CR. Accordingly, all included injuries consisted either of perforating injuries with posterior exit wounds involving Zone 2 or Zone 3, or penetrating injuries associated with a deep-impact IOFB, defined as extension into the choroid with or without scleral involvement. In addition, the ocular trauma score (OTS) was retrospectively determined as described by Kuhn et al.[20] All eyes demonstrated light perception or better visual acuity prior to surgical repair.

Surgical Technique

All surgical procedures were performed by an experienced vitreoretinal surgeon (AHD) under general anesthesia using three-port, 23-gauge or 25-gauge PPV with a non-contact wide-field viewing system (EIBOS, Moller-Wedel GmbH, Germany). When indicated, pars plana lensectomy or phacoemulsification was carried out at the surgeon's discretion. The vitrectomy was performed utilizing triamcinolone acetonide to improve visualization of any residual vitreous at the posterior pole, particularly around the impact site. The macular internal limiting membrane was peeled only in cases where the retinal lesion was located close to the fovea. When required, perfluorocarbon liquid (PFCL) was used as intraoperative retinal tamponade to stabilize the posterior retina. After complete vitreous removal, the retina was examined for incarceration or direct injury, including deep impact by an IOFB. The chorioretinectomy was subsequently carried out using a vitreous cutter to excise incarcerated retinal tissue, extending through the choroid to expose bare sclera at sites of deep impact or IOFB perforation. Endodiathermy at maximum power was applied to demarcate the CR area, and transient elevation of infusion pressure to 60 mmHg was used to minimize intraocular bleeding. After removal of damaged tissue, endolaser retinopexy was applied circumferentially to the margins of the chorioretinectomy within healthy retina wherever possible, sparing the posterior pole. All cases underwent a fluid–air exchange followed by long-acting gas (perfluoropropane, C_3F_8) or silicone oil (1000 or 5000 centistokes) endotamponade.

Outcome Measures

Demographic and clinical data extracted from patient records included age, sex, laterality, injury type (mechanism), cause of injury, location of entrance (zone), and IOFB exit/impact site, time to vitreoretinal surgery, best-corrected visual acuity (BCVA) before and after surgery, number of vitreoretinal surgeries, rate of PVR, anatomical outcome, and globe survival.

The primary outcome measures were BCVA, rate of PVR, anatomical success, and globe survival at the final follow-up examination. Additional documented findings included corneal scarring/corneal decompensation and direct macular injury secondary to the IOFB.

Best-corrected visual acuity values were expressed in logarithm of the minimum angle of resolution (logMAR) notation as described by Ferris et al.[21] Hand movements (HM) and counting fingers (CF) vision were assigned logMAR values of 3.0 and 2.0, respectively, according to the method proposed by Holladay.[22] In this study, light perception (LP) was given a logMAR value of 4.0,[14] whereas no light perception (NLP) was not assigned a logMAR value.

Proliferative vitreoretinopathy was defined as the presence of any epiretinal or subretinal membrane proliferation. Anatomical success was defined as complete retinal attachment in the absence of silicone oil tamponade. Globe survival was defined as complete retinal attachment, intraocular pressure above 6 mmHg, and BCVA of LP or better.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows (Version 21.0; IBM Corp., Armonk, NY, USA). A p-value of <0.05 was considered statistically significant. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean ± standard deviation (SD) or median (range), as appropriate. Categorical variables were expressed as numbers (n) and percentages (%). Changes in BCVA between baseline and final follow-up were analyzed using the Wilcoxon signed-rank test.

RESULTS

Of 283 OGIs presenting during the study period, 41 eyes from 35 patients who underwent PPV with prophylactic CR for deadly weapon-related trauma were included in the analysis. Patient demographics, injury characteristics, and associated clinical findings are presented in Table 1. The mean age was 30.9±9.4 years (median 28 years, range 19–61 years). Among the 35 patients, 31 were male (88.6%) and 4 were female (11.4%). Twenty-two (53.6%) right eyes and 19 (46.4%) left eyes were injured, whereas 6 (17.1%) patients experienced bilateral eye injuries.

The majority of eyes (38 eyes, 92.7%) had perforating eye injuries, while 3 (7.3%) eyes had an IOFB associated with deep impact. The causes of injury included improvised explosive devices (IED) in 20 eyes (48.8%), hand grenades in 11 eyes (26.8%), landmines in 8 eyes (19.5%), and rocket-propelled grenades (RPG) in 2 eyes (4.9%). With respect to the location of entrance (zone), zone 3 involvement was most frequent (58.5%), followed by zone 2 (24.4%) and zone 1 (17.1%). All IOFB exit/impact sites, except for 3, were located posterior to the equator. Among these, 22 (53.6%) were located outside the vascular arcades, 12 (29.3%) within the vascular arcades, and 4 (9.7%) adjacent to the optic disc. The mean initial BCVA was 2.62±0.98 logMAR (range: 0.70-4.00 logMAR). Initial BCVA ranged from LP to CF in 90.2% of the eyes.

Surgical procedures, anatomical, and visual outcomes are summarized in Table 2. Patients underwent PPV with prophylactic CR surgery with a mean interval time of 5.9±2.7 days (range: 0–17 days) following the primary globe repair. In half of the eyes (22 eyes, 53.6%), C3F8 was preferred as the endotamponade. The mean number of PPV surgeries in each eye was 2.6±1.1 (range: 1-5), with a total of 105 surgeries. The mean follow-up following surgery was 32.8±16.6 months (range: 13-71 months).

The mean final BCVA was 1.18±1.20 logMAR (range: 0.10–4.00 logMAR), representing a statistically significant improvement compared with baseline values (p<0.001). Final BCVA ranged from 20/200 to NLP, with 28 (68.3%) patients attaining a BCVA of 20/200 or better. Corneal scarring or decompensation was observed in 4 (9.7%) patients, while direct macular injury caused by IOFB impact accounted for severe vision loss in 10 (24.4%) patients. PVR rates following initial PPV were 29.3% (12 of 41 eyes), decreasing to 14.6% (6 of 41 eyes) by the end of follow-up. The anatomical success rate was 85.4% (35 of 41 eyes), and the globe survival rate was 87.8% (36 of 41 eyes). Silicone oil was left in five eyes due to persistent hypotony.

Among eyes presenting with severe visual impairment at baseline, 20 eyes (48.8%) had HM or LP vision. In this subgroup, the mean baseline BCVA was 3.50±0.51 logMAR and improved significantly to 1.80±1.32 logMAR at final follow-up (p<0.001). Eight eyes (40.0%) achieved a final BCVA of ≥20/200. Anatomical success was achieved in 14 eyes (70.0%), and globe survival was maintained in 15 eyes (75.0%).

Eighteen eyes (43.9%) presented with retinal detachment (RD) at the time of PPV. In this subgroup, the mean final BCVA was 1.79±1.40 logMAR. PVR developed in 12 eyes (66.7%) after the initial PPV and persisted in 6 eyes (33.3%) at final follow-up. Anatomical success was achieved in 12 eyes (66.7%), and globe survival was maintained in 14 eyes (77.8%).

DISCUSSION

Deadly weapon–related open globe injuries represent one of the most devastating forms of ocular trauma, frequently associated with high-velocity impact, profound posterior segment damage, and a markedly elevated risk of PVR, which remains a major driver of anatomical failure and poor functional recovery. In this context, the present study evaluated PPV combined with CR in a homogeneous cohort of patients with DWOGI and demonstrated that this proactive surgical strategy is associated with meaningful visual improvement (≥20/200 vision in 68.3% of eyes), high anatomical sucess (85.4%), favorable globe survival (87.8%), and a low final PVR rate (14.6%) despite severe ocular damage.

The demographic and injury characteristics of our cohort

Table 1. Patient demographics, injury characteristics, and associated clinical findings

Patient	Age	Sex	Eye	Injury type	Cause of injury	Location of entrance site (Zone)	Location of IOFB exit /impact site	APD	RD	OTS
1	19	M	OD	Perforating	Hand grenade	Zone 1	within the vascular arcades	Yes	No	46
2*	23	M	OD	Perforating	Land mine	Zone 3	outside the vascular arcades	No	Yes	45
			OS	Perforating		Zone 3	adjacent to the optic disc	Yes	No	46
3*	28	M	OD	Perforating	IED	Zone 1	outside the vascular arcades	No	No	76
			OS	Perforating		Zone 3	within the vascular arcades	No	Yes	45
4	61	M	OD	Penetrating	Hand grenade	Zone 1	anterior to the equator	No	No	70
5	32	M	OS	Perforating	IED	Zone 3	within the vascular arcades	Yes	Yes	35
6	33	F	OD	Perforating	IED	Zone 2	anterior to the equator	No	No	76
7	26	M	OS	Perforating	IED	Zone 3	within the vascular arcades	No	No	56
8	25	M	OD	Perforating	Hand grenade	Zone 3	within the vascular arcades	Yes	Yes	35
9	28	M	OS	Perforating	IED	Zone 3	outside the vascular arcades	No	No	56
10*	29	M	OD	Perforating	IED	Zone 2	outside the vascular arcades	No	Yes	45
			OD	Perforating		Zone 3	within the vascular arcades	No	Yes	45
11	25	M	OS	Perforating	IED	Zone 3	outside the vascular arcades	No	Yes	45
12	21	M	OD	Perforating	Land mine	Zone 1	outside the vascular arcades	No	Yes	45
13	33	M	OD	Penetrating	Hand grenade	Zone 1	outside the vascular arcades	No	No	70
14*	27	M	OD	Perforating	Hand grenade	Zone 2	outside the vascular arcades	No	No	56
			OS	Perforating		Zone 3	within the vascular arcades	No	Yes	45
15	35	F	OS	Perforating	IED	Zone 2	outside the vascular arcades	No	No	56
16	36	M	OD	Penetrating	Hand grenade	Zone 2	outside the vascular arcades	No	No	70
17	38	M	OS	Perforating	IED	Zone 3	within the vascular arcades	No	No	56
18	24	M	OD	Perforating	Land mine	Zone 3	outside the vascular arcades	No	No	56
19	28	M	OS	Perforating	Hand grenade	Zone 2	adjacent to the optic disc	Yes	No	46
20	23	M	OD	Perforating	IED	Zone 3	outside the vascular arcades	No	Yes	45
21*	28	M	OD	Perforating	IED	Zone 3	outside the vascular arcades	No	Yes	45
			OS	Perforating		Zone 2	outside the vascular arcades	No	No	56
22	47	M	OD	Perforating	Land mine	Zone 3	outside the vascular arcades	No	No	56
23	33	M	OS	Perforating	Land mine	Zone 3	outside the vascular arcades	No	No	76
24	24	M	OS	Perforating	Hand grenade	Zone 2	outside the vascular arcades	Yes	Yes	35
25	27	M	OS	Perforating	IED	Zone 1	outside the vascular arcades	No	No	56
26	52	F	OD	Perforating	Land mine	Zone 2	adjacent to the optic disc	Yes	Yes	35
27	25	M	OS	Perforating	IED	Zone 3	within the vascular arcades	No	Yes	45
28	37	M	OD	Perforating	Hand grenade	Zone 3	outside the vascular arcades	Yes	No	66
29	61	F	OD	Perforating	IED	Zone 3	outside the vascular arcades	No	No	56
30*	29	M	OD	Perforating	IED	Zone 3	within the vascular arcades	No	Yes	45
			OS	Perforating		Zone 3	within the vascular arcades	No	Yes	45
31	25	M	OS	Perforating	RPG	Zone 1	anterior to the equator	No	No	56
32	23	M	OD	Perforating	Land mine	Zone 3	adjacent to the optic disc	Yes	Yes	35
33	29	M	OS	Perforating	RPG	Zone 3	outside the vascular arcades	Yes	No	46
34	33	M	OS	Perforating	IED	Zone 3	within the vascular arcades	No	Yes	45
35	36	M	OD	Perforating	Hand grenade	Zone 2	outside the vascular arcades	No	No	56

APD: Afferent pupillary defect; BCVA: Best corrected visual acuity; CF: Counting fingers; F: Female; HM: Hand motion; IED: Improvised explosive device; LP: Light perception; M: Male, OD: Right eye; OS: Left eye; OTS: Ocular trauma score; RD: Retinal detachment; RPG: Rocket-propelled grenades. * Patient who underwent surgery on both eyes.

Table 2. Surgical procedures, anatomical and visual outcomes

Patient	Time to first PPV, days	Endo tamponade	PPVs, n	Follow-up, mo	Initial BCVA (decimal)	Corneal scar/ corneal decompensation	Macular injury	PVR after first PPV	PVR at the end of follow-up	Final BCVA (decimal)	Anatomical success	Globe survival
1	10	C3F8 gas	2	55	CF	No	No	No	No	0.6	Yes	Yes
2*	5	silicone oil	3	26	HM	No	No	Yes	No	0.1	Yes	Yes
	5	silicone oil	2	26	LP	No	No	No	No	CF	Yes	Yes
3*	7	C3F8 gas	1	14	0.1	No	No	No	No	0.3	Yes	Yes
	4	silicone oil	4	14	HM	No	Yes	No	Yes	NLP	No	Yes
4	4	C3F8 gas	1	46	CF	Yes	No	No	No	0.5	Yes	Yes
5	12	silicone oil	3	14	LP	No	Yes	Yes	Yes	LP	No	No
6	5	C3F8 gas	1	23	0.2	No	No	No	No	0.8	Yes	Yes
7	5	C3F8 gas	2	17	HM	No	Yes	No	No	0.2	Yes	Yes
8	17	silicone oil	3	21	LP	No	Yes	Yes	Yes	LP	No	No
9	4	C3F8 gas	2	35	HM	No	No	No	No	0.5	Yes	Yes
10*	5	silicone oil	3	16	CF	No	No	No	No	0.4	Yes	Yes
	5	silicone oil	5	16	CF	No	Yes	Yes	No	CF	Yes	Yes
11	8	C3F8 gas	2	23	CF	No	No	Yes	No	0.4	Yes	Yes
12	5	C3F8 gas	2	49	LP	Yes	No	Yes	No	0.3	Yes	Yes
13	6	C3F8 gas	2	61	CF	No	No	No	No	0.7	Yes	Yes
14*	7	C3F8 gas	2	35	CF	No	No	No	No	0.4	Yes	Yes
	5	silicone oil	4	35	LP	No	Yes	Yes	No	HM	Yes	Yes
15	10	C3F8 gas	1	71	CF	No	No	No	No	0.6	Yes	Yes
16	0	C3F8 gas	1	54	CF	No	No	No	No	0.7	Yes	Yes
17	6	C3F8 gas	2	32	CF	No	No	No	No	0.5	Yes	Yes
18	5	C3F8 gas	2	25	CF	No	No	No	No	0.3	Yes	Yes
19	9	C3F8 gas	2	36	CF	No	No	No	No	0.1	Yes	Yes
20	7	C3F8 gas	3	19	HM	No	No	No	No	0.2	Yes	Yes
21*	6	silicone oil	4	63	LP	No	No	No	Yes	NLP	No	No
	3	C3F8 gas	2	63	CF	No	No	No	No	0.2	Yes	Yes
22	6	C3F8 gas	2	32	CF	No	No	No	No	0.2	Yes	Yes
23	6	C3F8 gas	2	38	0.1	No	No	No	No	0.2	Yes	Yes
24	8	silicone oil	4	13	HM	No	No	Yes	No	0.1	Yes	Yes
25	5	C3F8 gas	2	26	HM	Yes	No	No	No	0.3	Yes	Yes
26	5	C3F8 gas	2	14	CF	No	No	Yes	No	0.1	Yes	Yes
27	6	silicone oil	5	26	LP	No	Yes	Yes	Yes	NLP	No	No
28	4	C3F8 gas	2	49	0.1	No	No	No	No	0.4	Yes	Yes
29	6	silicone oil	3	12	CF	No	No	No	No	0.1	Yes	Yes
30*	4	silicone oil	4	57	LP	No	Yes	Yes	Yes	NLP	No	No
	4	silicone oil	5	57	LP	No	Yes	Yes	No	LP	Yes	Yes
31	4	silicone oil	2	28	HM	Yes	No	No	No	CF	Yes	Yes
32	4	silicone oil	3	27	HM	No	No	No	No	0.1	Yes	Yes
33	5	silicone oil	2	25	HM	No	No	No	No	CF	Yes	Yes
34	6	silicone oil	4	22	LP	No	Yes	No	No	CF	Yes	Yes
35	4	silicone oil	2	32	CF	No	No	No	No	0.5	Yes	Yes

BCVA: Best corrected visual acuity; C3F8: Perfluoropropane; CF: counting finger; F: Female; HM: Hand motion; LP: Light perception; Mo: Months; NLP: No light perception; PPV: Pars plana vitrectomy; PVR: Proliferative vitreoretinopathy. * Patient who underwent surgery on both eyes.

highlight the extreme severity of the included cases. The vast majority of eyes sustained perforating injuries, and most IOFB exit/impact sites were located posterior to the equator, with 43.9% of eyes showing initial RD. Importantly, injuries were predominantly caused by high-energy explosive devices, including IED (48.8%), hand grenades (26.8%), landmines (19.5%), and RPG (4.9%), which are known to produce combined blast and ballistic effects with extensive posterior segment damage. In a historical DWOGI series from our department, reported by Sobacı et al.,[23] zone 3 involvement and explosive mechanisms such as landmines and hand grenades were associated with the worst visual outcomes, with PVR accounting for 30.4% of postoperative failures. Similarly, large clinical series of perforating OGIs with posterior exit wounds and deep-impact IOFBs have demonstrated high-risk injury patterns.[13-16] Weichel et al.[13] reported that 87.5% of eyes had preoperative RD, and 56.2% had direct macular injury, while Ozdek et al.[14] noted posterior pole involvement in 77% of perforating injuries in their chorioretinectomy series. Against this background, the patient population included in the present study represents a worst-case scenario within the spectrum of OGIs, underscoring the clinical relevance of achieving the outcomes reported herein.

The timing of vitreoretinal intervention represents another critical determinant of posttraumatic outcomes. In our series, PPV with prophylactic CR was performed at a mean of 5.9±2.7 days following primary globe repair, and 43.9% of eyes already demonstrated RD at the time of PPV. This finding reflects both the severity of the initial trauma and the rapid onset of posterior segment pathology characteristic of deadly weapon injuries. Experimental and clinical studies indicate that cellular mediators of PVR, including retinal pigment epithelial cells and fibroblasts, begin proliferating within hours after trauma, particularly in the presence of intravitreal hemorrhage.[24] Accordingly, early removal of the vitreous scaffold and elimination of incarcerated retinal tissue at the wound or impact site represent biologically plausible strategies to interrupt the cascade leading to irreversible scarring.[25,26] Supporting this concept, Ferreira et al.[15] reported superior functional outcomes with early vitrectomy with prophylactic CR in perforating injuries, with 58% of early-treated eyes achieving ≥40/200 compared with 17% in delayed cases. The rationale for even earlier intervention is further emphasized by Kuhn and Schrader, who demonstrated that PPV combined with prophylactic CR performed within 100 hours in high-risk injuries was associated with a 16% PVR rate and no cases of PVR originating from the CR site.[17] Although the average timing in our cohort extended beyond this ≤100-hour window, our results suggest that a prophylactic CR strategy may still confer substantial benefit when surgery is performed during the first post-injury week in a tertiary referral setting.

Despite profoundly poor baseline visual acuity (most eyes presenting with LP or CF vision), significant functional improvement was observed over long-term follow-up, with final BCVA improving to 1.18±1.20 logMAR and 68.3% of eyes achieving ≥20/200 vision. This degree of functional recovery is notable, given the clinically relevant proportion of direct macular injury and posterior pole involvement in the cohort. In comparison, Monteiro and Meireles reported ≥20/200 vision in 64.5% of eyes following prophylactic CR,[16] whereas Ozdek et al.[13] reported ≥20/200 in 30.8% of eyes despite 100% globe survival.[14] Similarly, a comparative analysis of chorioretinectomy versus non-chorioretinectomy in combat-related ocular injuries demonstrated that final BCVA ≥20/200 was achieved in 54% of the chorioretinectomy group, compared with only 11% in the non-chorioretinectomy group. Taken together, these outcomes indicate that prophylactic CR may confer a substantial protective effect on visual function in severely traumatized eyes. The relatively high proportion of eyes retaining ambulatory vision, despite extensive posterior segment involvement and frequent macular damage, underscores the potential role of this approach in mitigating the long-term functional consequences of devastating ocular injuries.

The most critical finding of the present study relates to PVR prevention. Historical cohorts of severe OGIs, in particular those involving perforating mechanisms or deep-impact IOFBs, have consistently reported PVR rates exceeding 40–60%.[3-5] In contrast, the final PVR rate in our series was 14.6%, despite the inclusion of exclusively high-risk eyes with extensive posterior segment involvement. Although PVR developed in 29.3% of eyes after the initial PPV, subsequent surgical interventions resulted in a substantial reduction to 14.6% at final follow-up, suggesting that prophylactic CR confers a sustained protective effect rather than merely delaying scar formation. These findings are consistent with prior CR-based strategies. Kuhn and Schrader reported a 16% PVR rate following PPV and prophylactic CR in high-risk injuries,[17] whereas Monteiro and Meireles observed a final PVR rate of 6.5%, noting that PVR incidence decreased after additional surgeries, particularly when even partial CR was initially performed.[16] Similarly, Ferreira et al.[15] and Ozdek et al.[14] reported final PVR rates of 11% and 15.3%, respectively, in their chorioretinectomy series.

Anatomical success and globe survival represent particularly meaningful outcomes in this context. In our cohort, anatomical success was achieved in 85.4% of eyes and globe survival in 87.8%, with a minority requiring long-term silicone oil tamponade due to persistent hypotony. These results compare favorably with other published series. Monteiro and Meireles reported anatomical success of 80.6% and globe survival of 96.8%,[16] while Ozdek et al.[14] reported globe survival of 100% with retinal attachment in 84.6% of eyes. In a ruptured globe following blunt trauma mechanism, Mura et al.[18] reported globe survival of 100%, anatomical success of 73%, and a PVR rate of 13% following large CR for blunt ruptured globes, with ≥20/200 vision in 67% of eyes, showing similar outcomes despite differing injury etiologies. These crossstudy comparisons support the concept that chorioretinectomy-based strategies can promote globe preservation and stable retinal attachment in eyes at high risk of tractional scarring.

The strengths of the present study include a well-defined, homogeneous DWOGI cohort, long follow-up, and consistent surgical technique performed by an experienced vitreoretinal surgeon. By focusing on a high-risk subgroup rather than a broad ocular trauma spectrum, the study provides clinically actionable insights into the management of eyes most likely to develop PVR and catastrophic anatomical failure. Limitations include the retrospective design and absence of a contemporaneous non-CR control group, which limits definitive causal inference. However, ethical and practical considerations render randomized comparisons challenging in this setting, particularly given the historically poor outcomes associated with similar injury patterns.

CONCLUSION

In conclusion, PPV combined with prophylactic CR appears to be an effective and biologically sound strategy for managing DWOGIs at high risk for PVR. By proactively addressing retinal incarceration and minimizing the cellular drivers of post-traumatic scarring, this approach can achieve low final PVR rates (14.6%), high anatomical success (85.4%), and favorable globe survival (87.8%) despite extensive posterior segment trauma. Future prospective and multicenter studies are warranted to further refine patient selection and optimize surgical timing. However, current evidence supports the consideration of prophylactic chorioretinectomy as an integral component of the surgical management of the most severe forms of ocular trauma.

Ethics Committee Approval: This study was approved by the Health Sciences University Gülhane Scientific Research Ethics Committee (Date: 23.12.2025, Decision No: 2025-617).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Ölümcül silahlara bağlı açık göz yaralanmalarında proflaktik koryoretinektomi

AMAÇ: Ölümcül silahlara bağlı açık göz yaralanmalarında (AGY) pars plana vitrektomi (PPV) ve profilaktik koryoretinektomi (KR) cerrahisinin anatomik ve fonksiyonel sonuçlarının değerlendirilmesi

GEREÇ VE YÖNTEM: Kasım 2016-Ekim 2024 arasında ölümcül silahlara bağlı AGY nedeniyle PPV ve proflaktik KR uygulanan olgulara ait tıbbi kayıtlar retrospektif olarak incelendi. Demografik özellikler, yaralanmanın tipi, yaralanma nedeni, yaralanma zonu, göz içi yabancı cisim (GİYC) etki/çıkış yeri, en iyi düzeltilmiş görme keskinliği (EİDGK), proliferatif vitreoretinopati (PVR) oranları, anatomik başarı ve glob sağkalımı değerlendirildi.

BULGULAR: Toplam 283 AGY olgusundan, ölümcül silahlara bağlı AGY nedeniyle PPV ve profilaktik KR uygulanan 35 hastaya ait 41 göz analize dahil edildi. Olguların yaş ortalaması 30.9±9.4 yıl olup, %88.6'sı erkekti. Gözlerin 38'inde (%92.7) perforan, 3'ünde (%7.3) GİYC ile birlikte penetran yaralanma mevcuttu. Yaralanma nedenleri 20 gözde (%48.8) el yapımı patlayıcı, 11 gözde (%26.8) el bombası, 8 gözde (%19.5) mayın ve 2 gözde (%4.9) roketatar idi. Yabancı cisim çıkış/etki bölgesi olguların 38'inde (%92.7) arka kutup yerleşimli olup; bunların 22'sinde (%53.6) vasküler ark dışında, 12'sinde (%29.3) vasküler ark içinde ve 4'ünde (%9.7) optik disk komşuluğundaydı. Başlangıç EİDGK ortalama 2.62±0.98 logMAR olup, gözlerin %90.2'si ışık hissi pozitifliği ile parmak sayma aralığındaydı. PPV primer tamirden ortalama 5.9 ±2.7 gün sonra uygulandı ve cerrahi sırasında olguların %43.9'unda retina dekolmanı mevcuttu. Ortalama PPV sayısı 2.6±1.1 idi. Olguların %51.2'sinde endotamponad olarak C3F8 gaz kullanıldı. Ortalama 32.8±16.6 aylık takip sonunda sonuç EİDGK 1.18±1.20 logMAR'a anlamlı şekilde düzeldi ($p<0.001$). Olguların %68,3'ünde son EİDGK 20/200 ve üzerinde idi. Postoperatif son kontrolde PVR oranı %14.6 (6/41), anatomik başarı oranı %85.4 (35/41) ve glob sağkalım oranı %87.8 (36/41) idi.

SONUÇ: Ölümcül silahlara bağlı açık göz yaralanmalarında PPV ile kombine profilaktik KR, ileri derecede posterior segment hasarına rağmen PVR gelişimini önleyebilen ve yüksek anatomik başarı, glob sağkalımı ve anlamlı görsel iyileşme sağlayan etkili bir tedavi seçeneği olarak görünmektedir.

Anahtar sözcükler: Açık göz yaralanması; göziçi yabancı cisim; koryoretinektomi; oküler travma; ölümcül silah; penetran göz yaralanması; ölümcül silah; perforan göz yaralanması; proliferatif vitreoretinopati.

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