



# Efficacy of 23-Gauge Pars Plana Vitrectomy with Intraocular SF6 Gas Tamponade for the Treatment of Intraocular Foreign Body

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## Abstract

**Background:** Penetrating ocular injuries associated with intraocular foreign body (IOFB) can lead to severe visual loss and despite improvement in microsurgical techniques, IOFB removal is one of the most challenging procedures in ophthalmology.

**Objectives:** The aim of this study was to evaluate the treatment outcomes of 23-gauge (23-G) pars plana vitrectomy (PPV) and intraocular SF6 gas tamponade for the management of patients with intraocular foreign body and attached retina with superior full thickness retinal breaks.

**Methods:** In this prospective study, 23-G PPV was performed to manage patients with IOFB and attached retina and with full thickness retinal breaks. In patients with traumatic cataract and ruptured anterior and posterior lens capsule, IOFB was removed through limbal incision, yet in cases with intact lens capsule or without cataract, IOFB was removed through extended sclerotomy. Careful intraoperative barrier laser was performed and the vitreous cavity was filled with SF6 gas. All patients were followed-up for at least six months.

**Results:** Ten eyes of ten patients were included in this study. The IOFB was removed through limbal incision in five eyes and through extended sclerotomy in five eyes. Lensectomy was done in eight eyes, in which primary intraocular lens (IOL) was implanted in seven eyes and secondary IOL (iris claw IOL) was implanted in one eye three months later. Visual acuity improved from  $1.22 \pm 0.36$  to  $0.26 \pm 0.18$  logMAR ( $P = 0.007$ ). No major intra-operative or post-operative complication, such as retinal detachment or endophthalmitis, occurred.

**Conclusions:** The 23-G PPV with intraocular SF6 gas tamponade was an effective and safe treatment modality for the management of eyes with small IOFBs and attached retina with full thickness retinal break.

**Keywords:** Intraocular Foreign Body, 23-Gauge, Vitrectomy, Retinal Detachment

## 1. Background

Penetrating ocular trauma, associated with intraocular foreign body (IOFB), is a common type of ocular injury that is found in 17% to 41% of open globe injuries (1-5). This type of ocular trauma is one of the main causes of visual loss, especially in young males, and 66% of ocular trauma involving IOFB occur between 21 and 40 years of age (2, 3). Ocular damage secondary to IOFBs is often associated with corneal and/or scleral laceration, hyphema, vitreous hemorrhage, lens trauma, retinal damages or retinal detachment (RD), and may be accompanied by endophthalmitis (6-8). Visual prognosis mostly depends on associated damages to the ocular tissue; however, inappropriate surgical interventions may lead to poor visual outcomes and higher re-operation requirement (9). Despite improvement in microsurgical techniques, IOFB removal is one of the most challenging procedures in ophthalmol-

ogy (9). Today, pars plana vitrectomy is the treatment of choice for IOFBs (10, 11); however, hypotony, vitreous incarceration, and RD may occur (12, 13). Also, late onset complications, including epiretinal membrane, fibrovascular proliferation, RD, and proliferative vitreoretinopathy (PVR) may also occur (14-16).

In the present study, the researchers assessed the outcomes of 23-gauge (23-G) pars plana vitrectomy (PPV) and gas tamponade for the extraction of small IOFBs associated with full thickness retinal damages secondary to explosive trauma.

## 2. Objectives

In this study, the researchers aimed at evaluating the efficacy of 23-G PPV and intraocular SF6 gas tamponade for the management of patients with intraocular foreign

body and attached retina with superior full thickness retinal breaks.

### 3. Methods

In this prospective study, performed between May 2015 and April 2016, ten eyes from ten patients, who referred to the Ophthalmology Clinic of Baqiyatallah Hospital were included. All ocular injuries occurred secondary to explosive injuries during violence injury from neighboring countries. Patients with retained small posterior segment IOFBs associated with superior retinal breaks or retinal full thickness damages yet without RD were enrolled.

Pre-operative ophthalmic examination, including visual acuity measurement, slit lamp examination, and also orbital CT-Scan were performed. Follow-up visits were done one day, one week and then one, three, and six months after the surgery. Best corrected visual acuity (BCVA) measurement, slit lamp examination, intraocular pressure (IOP) measurement, and indirect ophthalmoscopy were done. All patients underwent 23-G PPV to remove IOFB. All surgeries were done by a single surgeon (T. H).

#### 3.1. Surgical Technique

All surgeries were done under general anesthesia. In cases with traumatic cataract, lensectomy and intraocular lens implantation (if possible) were performed using an anterior limbal incision. The 23-G cannula was placed in the inferotemporal quadrant for the infusion port and two 23-G cannulas were placed in the superotemporal and superonasal quadrants. Deep vitrectomy was done and then intravitreal triamcinolone was injected and posterior vitreous detachment (PVD) was induced if it did not happen by itself. Small volumes of perfluorocarbon (PFCL) was injected to protect the macula from inadvertent foreign body falling. Vitreous base was shaved in all cases. Supratemporal cannula was removed and supratemporal sclerotomy was extended using a 20-G micro vitreoretinal (MVR) blade.

In cases with traumatic cataract and opened lens capsule, the foreign body was transposed from vitreous cavity to the anterior chamber using 20-G IOFB forceps and then removed from a limbal incision. In eyes with intact lens capsule or in eyes without cataract, in which lensectomy was not performed, the IOFB was removed from the pars plana incision. The IOL was implanted if possible.

In all cases, retinal tear or full thickness retinal damages were present in the eight superior clock hours. Barrier laser was done and careful evaluation was performed to find all retinal injuries and barrier laser was done for any suspected retinal damages. Air-fluid exchange was performed and SF6 20% was injected through the infusion

port. The extended sclerotomy was sutured at the end of the surgical procedure.

The size of the foreign bodies was reported based on the length of the longest part that was measured by the caliper.

### 4. Results

A total of ten eyes of ten patients with IOFB were enrolled in this prospective study and all of them completed at least six months of follow-up. The details of all the cases are summarized in [Table 1](#). All of the cases were male and had ocular damages secondary to explosive trauma. The mean age was  $27 \pm 6$  years.

Traumatic cataract was present in eight eyes, who underwent lensectomy. The IOL was implanted in the capsular bag in three eyes and in the ciliary sulcus in four eyes. In one patient, the traumatized eye remained aphakic because of severe lens trauma and inadequate capsular rim. Iris claw lens (Artisan) was implanted in this eye three months later. Therefore, primary IOL was implanted in seven eyes and in one eye, secondary IOL was implanted in the second procedure.

The IOFB was removed through limbal incision in five cases and through extended pars plana sclerotomy in five eyes. In two eyes, the lens was clear and remained stable until the last follow-up visit. The mean foreign body size was 1.95 mm.

Significant improvement in BCVA was detected at the six-month follow-up in nine cases and BCVA remained unchanged in one patient, in which traumatic optic atrophy was detected. The mean baseline logMAR visual acuity was  $1.22 \pm 0.36$  and the mean BCVA at the final follow-up visit was  $0.26 \pm 0.18$  ( $P = 0.007$ ). Intra-operative complications were not observed. Early post-operative anterior segment inflammatory reaction occurred in three eyes, in which IOL was implanted in the ciliary sulcus and completely resolved using topical and systemic steroid therapy. Late post-operative complications, including RD, choroidal detachment, hypotony, epiretinal membrane or IOP elevation were not seen in any of the cases.

### 5. Discussion

This study showed that 23-G PPV with intraocular SF6 gas tamponade is an effective treatment modality for the management of eyes with small IOFBs in association with superior full thickness retinal breaks and attached retina.

Penetrating ocular injuries, associated with IOFB, may result in devastating eye damages and profound visual disturbance, depending on several factors, such as initial visual acuity, location and nature of IOFB, presence of RD or

**Table 1.** Pre- and Post-Operative Characteristics of Patients

Patient Number	Age	Size of IOFB (mm)	Cataract Surgery/Primary IOL Implantation	Site of IOFB Removal	LogMAR Pre-Operative BCVA	LogMAR Post-Operative BCVA (at 6 Months Follow-Up)
1	44	1.5	Yes/Yes	Limbal incision	1.30	0.20
2	26	2	Yes/Yes	Sclerotomy	1.00	0.20
3	23	2	Yes/Yes	Limbal incision	1.00	0.10
4	23	1.5	Yes/Yes	Limbal incision	1.80	0.20
5	27	1	Yes/Yes	Limbal incision	1.30	0.30
6	24	2.5	Yes/Yes	Sclerotomy	1.00	0.20
7	30	2	Yes/Yes	Sclerotomy	1.80	0.10
8	25	3	Yes/No	Limbal incision	1.30	0.40
9	27	2	No	Sclerotomy	1.00	0.20
10	21	2	No	Sclerotomy	0.70	0.70

Abbreviations: BCVA, best corrected visual acuity; IOFB, intraocular foreign body; IOL, intraocular lens; LogMAR, logarithm of the minimum angle of resolution.

endophthalmitis, type of intraocular tamponade, associated ocular tissue damages, the status of the macula, and occurrence of surgical complications (17).

Nowadays, the best treatment option for IOFBs is PPV (18, 19). Recent advances in microsurgical techniques have improved the prognosis of eyes with IOFBs (20, 21). In this study, the researchers used 23-G PPV for the management of eyes with small IOFB with retinal breaks and no pre-operative RD. In the prospective study, Singh et al. evaluated the outcomes of IOFB removal via limbus using sutureless 23-G PPV (22). They included 14 eyes from 14 patients with IOFB and corneal or limbal penetrating injury associated with traumatic cataract and anterior or posterior lens capsule rupture. Retinal damages were not presented in any of the cases. After posterior approach lensectomy, they used 23-G PPV and IOFB removal through limbal incision without expansion of sclerotomy site. They reported that the mean BCVA improved significantly at 12 months follow-up with no major post-operative complications. Unlike Singh et al. study, all cases in the present study had full thickness retinal breaks and intraocular gas tamponade was used. Also, in cases without lens capsule damage, the researchers removed the IOFB through extended sclerotomy. The IOL was not implanted in Singh et al. study, yet the current study showed that primary IOL implantation is safe and can prevent secondary surgical procedures.

At this time, many vitreoretinal specialists have used small gauge PPV for the management of vitreoretinal disorders; however, small gauge vitrectomy is not usually used in the treatment of ocular injuries with IOFB. In this study, the researchers used small gauge (23-G) PPV for the treatment of retained posterior segment IOFBs. The BCVA

was improved significantly in nine cases and remained unchanged in one eye, in which traumatic optic neuropathy was found.

The RD is the most important cause of visual loss in eyes with posterior segment IOFBs (17). Despite improvement in surgical techniques, pre-operative or post-operative RD frequently occurs. Furthermore, RD was reported in 16% to 47% of eyes with IOFB (5, 23, 24). Post-operative RD following PPV and IOFB removal may be due to PVR development or missed retinal breaks or inadequate treatment of retinal breaks. In the present study, the researchers carefully found all retinal breaks or suspected full thickness retinal damages and treated all of them with careful barrier laser.

In Yuksel et al. study, RD occurred in 5.5% of cases following 23-G PPV (17). No case of RD occurred in the current study during the six months follow-up period. In Yuksel et al. study, gas tamponade was used in 33.8% of cases and silicone oil was used in 22.6%. In 38.8% of eyes, no intraocular tamponade was used.

In a retrospective study, Rejdak et al. evaluated the efficacy and safety of 23-G PPV and intra-operative protection of macula with PFCL for the management of 42 eyes with posterior segment IOFB (9). Foreign body was removed through corneal incision in 22 eyes and through sclerotomy in 20 eyes. Silicone oil in 31 eyes, SF6 gas in five eyes, and air in four eyes were used as an intraocular tamponade and two eyes required no tamponade. They reported that post-operative RD occurred in 17% of eyes. In the Rejdak et al. study, at mean of 11.7 months follow-up, visual acuity was improved in 42.9%, remained unchanged in 21.4%, and decreased in 35.7% of eyes. In comparison to the current study, the size of IOFBs was larger in Rejdak et al. study

and most cases received silicone oil as an intraocular tamponade; however, the authors reported that no significant differences in visual acuity between the eyes with silicone oil, SF6 gas, air or no tamponade were detected. The use of silicone oil, as intraocular tamponade, may be associated with complications, including silicone oil emulsification, secondary glaucoma, cataract, and corneal degeneration. Also, reoperation requirement for silicone oil removal is another problem with using silicone oil. The use of intraocular gas tamponade will reduce these complications and the need for reoperation procedures.

In Rejdak et al. study, PFCL was used to protect the macula from falling foreign body during PPV and they reported that no intra-operative iatrogenic macular damages had occurred. This study used PFCL during PPV to shield the macula and no macular damages occurred; however, in one eye, parafoveal macular damages was found due to foreign body hit and final BCVA increased to 4/10 in this eye.

Mahapatra and Rao described the outcomes of 20-G PPV for IOFB removal with simultaneous cataract extraction and IOL implantation (25). They reported that post-operative RD was seen in five out of 18 cases. This study found no cases of RD in the series following 23-G PPV for IOFB removal, therefore, small gauge (23-G) PPV may be safer than traditionally large gauge PPV.

### 5.1. Conclusions

The current study showed that 23-G PPV is an effective and safe modality for the management of eyes with posterior segment IOFB. Also, SF6 gas tamponade can be used safely in eyes with IOFB and attached retina associated with superior retinal breaks; however, larger studies with longer follow-up periods are required to confirm the findings.

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