Modified endoscope-assisted vitrectomy for missed intraocular foreign body.

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Background: *Reporting a case of missed IOFB managed by novel approach of modified endoscope-assisted vitrectomy using Endoscopic cyclophotocoagulation fiber-optic probe for IOFB retrieval.*

Case report: *Mr MY, a 58 years old Malay gentleman with no underlying medical illness presented with five-month history of left eye gradual onset, painless blurry vision. Symptoms were preceded by a history of high-velocity foreign body which entered the left eye while cutting grass with rotating blade cutter without eye protection, of which was self-treated with over-the-counter topical medications. No history of eye redness or floaters. Systemic examination was unremarkable. On presentation, vision was 6/6 OD and 6/36 OS. Left eye demonstrated rusty pigments on anterior lens capsule with anterior subcapsular cataract with retro-lental streak vitreous opacity and underlying flat retina. Right eye was normal. CT orbit showed radio-dense foreign body in left globe over posterior and infero-lateral to lens. Patient underwent left eye phacoemulsification and vitrectomy surgery. Intra-operatively noted siderosis of lens capsule with no intraocular foreign body (IOFB) found. Repeated imaging showed retained IOFB. Subsequently, he underwent modified endoscope-assisted vitrectomy using Endocyclophotocoagulation (ECP) fiber-optic probe which retrieved fibrosis-covered IOFB infero-temporal to posterior capsule.*

Conclusion: *Endoscope-assisted vitrectomy is safe and useful in IOFB retrieval by bypassing anterior segment opacities and visualization of anterior structures. The use of ECP probe in endoscope-assisted vitrectomy in this case, which has never been reported before, offers an innovative alternative in places where conventional ophthalmic endoscope is not readily available.*

Conflict of interest: *We declare that we have no conflict of interest*

Keywords: *Endoscope-assisted vitrectomy, intraocular foreign body, retina, endocyclophotocoagulation*

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Introduction

Ocular siderosis (OS) is a severe vision-threatening complication of retained iron-containing intraocular foreign body (IOFB).[1] An iron-containing IOFB usually undergoes oxidation, dissociation and subsequently leads to iron deposition in the intraocular epithelial structures, which most commonly involves the lens epithelium, iris and ciliary body epithelium, and the sensory retina, where its toxic effect disrupts cellular enzyme processes resulting in cell death.[2]

Management of OS depends on the timely detection of an occult IOFB as well as the optimum timing for its surgical removal to ensure better visual prognosis. Studies suggested that immediate IOFB removal results in possible decrease in risk of endophthalmitis, a decrease in the rate of proliferative vitreoretinopathy (PVR) and OS.[2,3] Different authors have reported various techniques to remove IOFB. However its surgery still imposes challenges to surgeons and risk of missed IOFB due to poor visualization of IOFB from associated trauma-induced anterior segment opacities and the location of IOFB itself.

Case report

Mr MY, a 58 years old Malay gentleman with no underlying medical illness presented with five-month history of left eye gradual onset, painless blurry vision. Symptoms were preceded by history of high-velocity foreign body which entered the left eye while cutting grass with rotating blade cutter without eye protection, few months prior to onset of symptoms, of which he sought treatment from a private general practitioner and later self-treated with over-the-counter topical medications. No history of eye redness or floaters. Generally, his systemic examination was unremarkable.

On presentation, vision was 6/6 OD and 6/36 OS. Anteriorly, examination of the left eye revealed clear cornea with quiet anterior chamber and no iris defect detected. Positive findings of the left eye examination were rusty pigments on anterior lens capsule with anterior subcapsular cataract and retro-lental streak vitreous opacity. The underlying retina appeared normal and flat (Figure 1-2). Examination of the right eye was normal.

Figure 1: Normal-looking fundus photo of left eye on presentation.

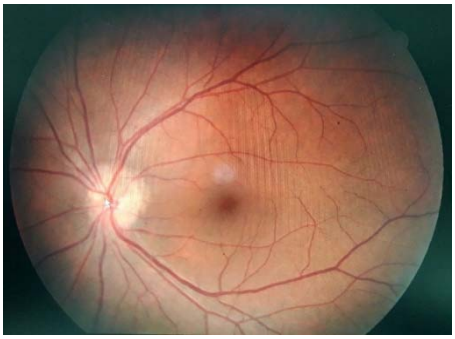
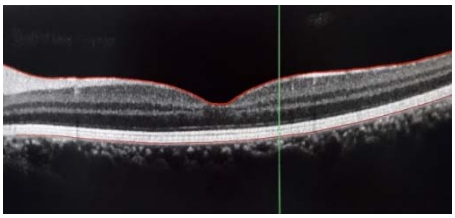


Figure 2: Optical Coherence Tomography (OCT) imaging of left eye on presentation.



Computed tomography (CT) orbit imaging was performed at presentation, which showed radio-opaque foreign body, suggestive of metallic IOFB in left globe over posterior and infero-lateral to lens, measuring 2.2mm (AP), 2.5mm (W), 2.6mm (CC) (Figure 3-4). Both eye optic nerves were intact and extraocular muscles were normal.

There were no signs of orbital fracture or other ocular abnormalities.

Figure 3: CT orbit coronal cut showing radio-opaque IOFB in infero-lateral aspect of the left globe.

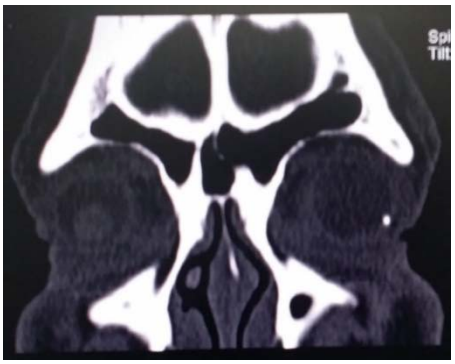


Figure 4: CT orbit axial cut showing radio-opaque IOFB in infero-lateral and posterior aspect of left eye globe.

Subsequently, he underwent a combined left eye phacoemulsification with intraocular lens implant and vitrectomy surgery with internal limiting membrane peeling. Intra-operatively noted siderosis of anterior lens capsule with localized fibrosis infero-temporal to the lens. However, no intraocular foreign body (IOFB) was found despite a meticulous internal search with magnet assistance and 360° of peripheral retina was checked for breaks and there were none noted. At 6 weeks post-operative review, his best corrected vision was 6/36 OS. Repeated imaging post-operatively showed retained IOFB, similar to pre-operative imaging (Figure 5-6).

Figure 5: Repeated CT orbit sagittal and coronal cut post-operatively revealed retained radio-opaque IOFB in posterior and infero-lateral aspect of left globe, similar location to those shown by initial CT orbit done on presentation.

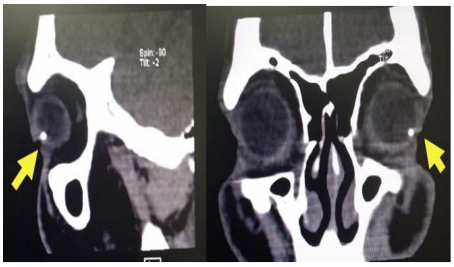
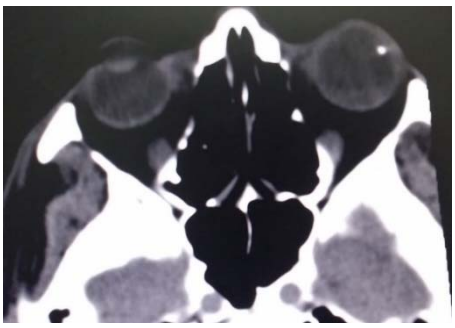


Figure 6: Repeated CT orbit axial cut post-operatively revealed left eye globe retained radio-opaque IOFB similar to pre-operative imaging.



Ultrasound biomicroscopy (UBM) was performed post-operatively which showed no obvious sign of foreign body in the ciliary body and angle of the left eye.

Post-operative review at 3 months revealed localized inferior rhegmatogenous retinal detachment (RRD) with no macular involvement. Hence we proceeded with modified endoscope assisted vitrectomy using Endocyclophotocoagulation (ECP) fiber-optic probe and oil tamponade for the inferior RRD. The Endocyclophotocoagulation fiber-optic probe helped to internally visualize the ciliary body, its processes (Figure 7) and subsequently assisted in retrieving a clump of fibrosis-covered magnetic IOFB from the infero-temporal aspect of the posterior capsule. The ECP probe also helped to demonstrate the dense tractional fibrosis surrounding the IOFB which was too anteriorly-located and hence, not reachable during the first pars plana vitrectomy surgery.

Figure 7: View of ciliary processes as captured by the Endocyclophotocoagulation (ECP) fiber-optic probe.

Post-operative recovery and removal of oil surgery were uneventful, however left eye vision remained poor at 6/36 at 6-months post-surgery. Full-field electroretinogram (ERG) done at almost 1 year post-operatively showed generalized diminished amplitudes suggesting of poor prognosis.

Discussion

This case highlights the catastrophic sequelae of missed or delayed presentation and management of Ocular Siderosis (OS). It has been postulated that development of OS following retained ferrous IOFB is variable but strongly related to the shape and size of the foreign body, its iron content, and the duration of metallic IOFB retention in the eye. Asencio-Duran et al reported the manifestation of OS as early as 18 days and up to as late as 12 years following initial ocular injury.[1]

At the moment, there are no clear guidelines or controlled trials on the management of ocular siderosis. This makes its treatment controversial with regards to a grey area between surgical intervention and conservative management of serial monitoring.[2] However, modern practice seems to advocate immediate removal of the IOFB due to the devastating consequences of OS.[3] The choice of surgical technique for removal of the retained IOFB is dependent on various factors, including the site and nature of the IOFB and the lens clarity.[1] The surgery may be done via an external or internal approach. Externally, a sclerotomy wound would be performed and an electromagnet would be used to retrieve the IOFB. An internal approach involves a pars plana vitrectomy (PPV) surgery followed by retrieval of the foreign body using forceps or magnet, in which this technique provides direct viewing and better control of the foreign-body removal procedure.[4,5,6]

Table 1: summarizes the different surgical approach in IOFB removal available in published articles.

References	Location	Patients	Injury-surgery interval	IOFB size	Extraction technique
Rusnak et al (2009) [7]	Czech republic	9 patients	1 – 12 days	1.5 – 5.0mm	Transscleral using magnet
Sabti and Raizada (2012) [8]	Kuwait	11 patients	1 – 3 days	No mention	Endoscope-assisted pars plana vitrectomy
Park et al (2013) [9]	South Korea	10 patients	No mention	2.75 ± 1.04mm	Viscoelastic capture
Singh et al (2014) [10]	India	14 patients	No mention	1-5mm	Translimbal
Yuksel et al (2015) [11]	Istanbul, Tukey	36 patients	14.2 ± 19.4 days	5.63mm	'T' or 'L' sclerotomy
Huang et al (2017) [12]	China	42 patients	27.9 - 29.2 days	No mention	prism contact lens and 23-gauge foreign body forceps

In our case, the IOFB was unable to be retrieved via the conventional internal approach technique. The repeated imaging post initial vitrectomy revealed persistent IOFB presence. Subsequently, the patient underwent a novel approach for IOFB removal using an Endocyclophotocoagulation (ECP) fiber-optic probe as a modified endoscope combined with pars plana vitrectomy to retrieve the missed IOFB. The use of an ECP probe in endoscope-assisted vitrectomy in this case, which has never been reported before, represents an innovative alternative in ophthalmologic endoscopic surgery and can be useful in places where normal ophthalmic endoscope is not readily available. The endoscope bypasses anterior segment opacities and assists in providing direct visualization of anterior structures which are not possible with conventional microscopic surgical view. Therefore, it helped to remove the missed IOFB near posterior capsule, which were unable to be located during the first conventional vitrectomy surgery done.

In a routine clinical setting, ECP is a cilioablative technique that allows direct photocoagulation of the ciliary processes with direct endoscopic assistance, which is generally used in management of glaucoma and plateau iris syndrome.[11] The endoscope consists of the image guide, the light guide, and the semiconductor diode laser guide via fiber-optic technology of 19, 20 or 23-gauge probe with a field of view ranging from 70° to 140° and depth of focus spanning 1–30 mm.[13] The probe tips are either straight or curved, which is applied via limbal or pars plana approach.[13] The 23-gauge probe is compatible with all 23-gauge vitrectomy trocar systems, which is the preferred choice for the pars plana approach, as in our case.

The probe was introduced via a pars planar wound, which is the approach of choice in pseudophakic eyes and provides the most complete view of the ciliary processes, as compared to the limbal approach. The missed IOFB was able to be visualized at slightly infero-temporal to the posterior capsule, as evidenced by the pre-operative imaging. The IOFB was then removed using forceps and the surgery was completed with vitrectomy/oil tamponade to address the patient's associated inferior RRD.

Although the first reported use of an endoscope in the human eye was in a case of ocular trauma to remove IOFB,[14] not much has been reported regarding endoscopic approach of IOFB retrieval and its surgical outcomes until now. Removing IOFBs without appropriate visualization may precipitate giant retinal tears resulting in disastrous visual outcomes.[15] Sabti and Raize[8] reported 11 open globe injuries with retained IOFBs, retinal tears and vitreous haemorrhage, which was treated endoscopically and demonstrated improved vision in 10 eyes following endoscopic vitrectomy. Nicoara et al[16] and Valmaggia et al[17] listed the predictors of poor visual outcome of IOFB as poor initial presenting of visual acuity, presence of an afferent papillary defect, and vitreous haemorrhage. A five-year study by Bai et al[18] reviewed 84 eyes of 80 patients with IOFB found a relation of poor visual outcome to initial presenting of visual acuity, larger size of IOFB, posterior segment of IOFB, and preoperative retinal detachment. Chow et al[19] found no statistically significant difference in visual outcome when comparing the use of an internal or external approach in metallic IOFB removal. To our knowledge, there is no literature that has specifically reported on usage of ECP fiber-optic

probe in anterior or posterior segment IOFB removal surgery.

The endoscopic approach provides surgeons with in vivo visualization of structures, rather than the contorted view via scleral depression, while offering multiple direct planes of view to reveal the exact location of anterior IOFB which were unable to be visualized via conventional microscopic view, which is evidenced in our case where the missed IOFB was embedded near infero-temporal of posterior capsule. Furthermore, the endoscope also assists in diagnostic purposes in traumatic-induced anterior segment opacities which impedes clear assessment of the optic nerve and retinal status. The flexible probe may also shed light for necessary intervention if indicated.

Despite its attractive benefits, the major differences in endoscopic approach and its instrumentation as compared to the conventional microscopic surgery creates a steep learning curve, which may be improved over times, practice and appropriate bedside positioning of the monitor once familiarity has been achieved.[20] Other challenges imposed by the endoscopic technique include inability to perform bimanual procedures, loss of binocular stereopsis and the foreign view from a remote monitor may decrease awareness of instrument location within the globe, relying on monocular clues such as the size of landmarks, intensity of illumination and changes in focus.[20] The constant changes in perspective of the endoscopy may also challenge surgeons who are accustomed to the bird's eye view of conventional microscopy, as rotational movements change intraocular orientation and disorientation may be compounded further by high magnification.[20]

In addition to the aforementioned technical challenges, the application of endoscope-assisted vitrectomy is still limited due to the unavailability of ocular endoscope or ECP probe in all eye centres, including Malaysia, due to the obvious financial burden and lack of expertise ophthalmic endoscopic surgery. Despite bypassing anterior segment opacities in the endoscopic ocular surgery, post-operative review will still be restricted by poor visualization in such cases and hence identification of complications such as re-detachments and endophthalmitis will still rely on ultrasonography imaging.[20]

Conclusion

A complete ophthalmic evaluation and radiological studies for detection of metallic IOFB are mandatory in patients with history suggestive of penetrating ocular injury to rule out retained or occult IOFB and timely removal of IOFB is crucial to prevent this sight-threatening condition.

Although the literature on endoscopic approach of IOFB removal surgery is currently limited, endoscope-assisted vitrectomy is safe and useful in IOFB retrieval as it offers anterior segment opacities bypass and direct visualization of anterior structures. The novel method of using ECP probe in endoscope-assisted vitrectomy offers an innovative alternative in places where conventional ophthalmic endoscope is not readily available.

Conflict of interest statement

We declare that we have no conflict of interest.

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