Ocular Trauma is one of the common entity in the practice of ophthalmology. Trauma is one of the important cause of vision loss especially in the younger age group. Improper diagnosis or management of retained intraocular foreign body (RIOFB) lead to sight threatening complications. Hence RIOFB needs to be meticulously worked up and managed. Appropriate diagnostic methods should be made use of in case of doubt regarding the exact location of foreign body. Here is the opinion from experts in the area of ocular trauma. The questions have been designed by Dr. Ravi B (RB): Senior Resident Uvea and Vitreo-retina services from R.P. Centre for Ophthalmic Sciences, All India Institute for Medical Sciences, Ansari Nagar, New Delhi.

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RB: What is the nature of foreign bodies you frequently encounter?

AK: The frequently encountered foreign bodies in our centre include metallic comprising of iron, copper or lead, alloys like steel and brass present in firearms and explosives, and non metallic like glass, stone, plastic, wood etc.

BG: In our clinical practice, we most commonly encounter cases with metallic FB, the majority of these being magnetic. The mode of injury is usually use of chisel and hammer, grinding or drilling machines, blast injuries or assault cases. The metallic FB is most commonly iron or steel and in other cases may be copper, aluminum and lead. In non-metallic FB, stone is a more common culprit in the eye amongst others. Organic FBs like vegetable matter although much more reactive and damaging to the eye are not often encountered by us.

CMS: Metallic foreign bodies, usually iron, are most frequently encountered as hammer-chisel injury is the commonest mode of injury. Glass, copper, lead, stone, wood are some of the other foreign bodies seen. Rare ones can be caterpillar hair and even contact lenses!

PMS: Most often metallic, irregular foreign bodies borne out of hammering or blast injuries.

RB: What is your preferred investigation in cases for localisation of FB? What all investigations do you do in a case of RIOFB?

AK: Besides a detailed clinical evaluation including BCVA, slit lamp biomicroscopy and examination (media permitting) of posterior segment examination with Indirect Ophthalmoscopy, imaging is required. Non contrast computed tomography (NCCT) is currently considered the “gold standard” for the detection, localization of both metallic foreign bodies. Routinely, axial sections separated by 3 to 5 mm are used as initial screening study for foreign bodies. Spiral CT is a new advancement which has helped overcome some of the limitations of conventional CT, like motion artefacts and prolonged examination time.
Experts Corner: Management of Retained Intraocular Foreign Body

However, studies comparing the detection of steel IOFBs measuring 0.06 mm or larger have shown no difference in sensitivity between spiral and conventional scanning CT, either imaging modality is probably adequate for detection of all but the smallest of IOFBs. It’s also important to be sure of the number of foreign bodies in cases of shotgun injuries.

Currently plain film X-rays alone are used as a screening modality for IOFBs. Standard B-scan ultrasonography can also be used to detect metallic IOFBs, but the sensitivity is user-dependent. However, USG B-scan provides with real time images with good resolution (0.1 mm to 0.01 mm) with multiple cuts, is non-invasive and inexpensive. Ultrasound bio-microscopy (UBM) is found to be especially helpful in the management of small, non-metallic IOFBs located in or near the anterior chamber.

**BG:** Our preferred investigation of choice in all cases of IOFB is a non-contrast CT Scan of the orbit. A CT scan with axial and coronal views with thin slices (<1.5 mm) is highly sensitive (~95%) for detection and localization of an IOFB and rules out the presence of a metallic FB. If negative, a MRI scan may be performed safely.

In a patient with acute trauma, a CT scan offers several advantages in the form of no manipulation with an open globe, minimal co-operation required from the patient, highly sensitive in detecting and accurately localizing IOFB, even multiple and anteriorly located FB and comparison of the radiodensity of the FB to that of the bone, may give an idea of the composition of the FB.

However, a CT scan may not detect a FB smaller than 0.7 mm, a wooden FB or a FB lying in close apposition to the sclera. A helical CT may be preferred over a conventional CT scan under such circumstances.

Other than a CT scan, the work up of an acute trauma patient with a suspected IOFB consists of several other investigations like:

- **a) X-ray orbit** – Although a less sensitive imaging modality compared to a CT scan, an X-ray orbit can be much more easily obtained in emergency settings in the hospital and can detect a radiopaque FB in majority of the cases.

- **b) Ocular ultrasonography** – USG B-scan of the eye is usually avoided in an open globe and may be performed after repair of the scleral or corneal perforation. It can detect a radiopaque or radiolucent FB which has ultrasonic characteristics including high reflectivity (~100%) persisting on low gain and acoustic shadowing. It can also diagnose associated ocular pathologies like vitreous hemorrhage, retinal detachment, choroidal detachment and double perforation of the globe. It also helps in the study of orbital apex when optic nerve avulsion is suspected and also in staging of orbital or vitreous hemorrhage.

- **c) MRI orbit** – An MRI may be performed after ruling out a metallic FB on CT scan for detection of small wooden or plastic FB not picked up on a conventional CT scan. It also helps in the study of orbital apex when optic nerve avulsion is suspected and also in staging of orbital or vitreous hemorrhage.

- **d) UBM** is done for localizing radiolucent FB in the anterior segment not detected on CT scan, especially in the ciliary region.

- **e) Gonioscopy** helps in detecting a FB in the angle, but cannot be performed in an open globe.

- **f) Electrical functions** of the retina are reserved for prognostic purposes and not done in every case.

**CMS:** CT scan is the preferred mode of foreign body localization. It helps in accurate detection of size, position (intraocular/extraocular/within the coats), number and characterization (metallic/ non metallic) of foreign bodies. It can be safely done if there is an associated open globe injury. Small foreign bodies especially if located anteriorly may sometimes be missed on CT scan. Spiral CT has a higher identification rate as compared to conventional CT thereby decreasing the incidence of false negative results. UBM is a useful adjunct to CT scan in detecting small non metallic foreign body in anterior chamber or ciliary body region. Detailed Slit lamp examination, as regards entry wound, corneal clarity, lenticular status and B scan ultrasonography are important investigations to plan out surgery. X-ray and Limbal ring localization were used earlier but are relatively obsolete in the CT scan era. Electroretinography is advisable if a chronic IOFB is found and siderosis is suspected.

**PMS:** Accurate localization of the foreign body however is not critical considering that we use vitrectomy techniques most often for foreign body removal. An imaging will however tell us if the foreign body is intraocular or extraocular or impaled in the coats of the eye, which will enable one to select an appropriate approach to its removal.

**RB:** What are the pre-operative prognostic factors in cases of IOFB?

**AK:** Size of foreign body is an important predictor of outcome. IOFBs > 3 mm carry a poor visual prognosis. Initial visual acuity <20/200 is also associated with poor visual outcome. Presence of retinal detachment, endophthalmitis and siderotic changes are all indicators of poor prognosis. Location of IOFBs is also an important predictor of outcome. IOFB in vitreous cavity carry a better prognosis than the ones impacted within the coats. IOFBs impacted close to or at the macula can lead to gross affection of vision.

**BG:** In our experience, the most important pre-operative prognostic factors in cases of IOFB are:

- **a) Visual acuity at presentation** – It is the most
important prognostic factor for operative outcome. An initial visual acuity of 6/60 or better is usually associated with good prognosis.

b) Pupillary reactions – Presence of an RAPD signifies damage to the optic nerve and hence carries a poor prognosis.

c) Time interval from the time of injury to presentation – All cases which present within 24hrs of the trauma usually have a better prognosis when appropriately managed.

d) Location and size of the primary wound – More anteriorly located wounds and of smaller size usually have a better prognosis than wounds located/extending posterior to the insertion of recti or associated with uveal tissue prolapsed. A wound size > 10mm also has a poorer prognosis.

e) Nature of FB – A small, sharp and metallic FB has a better prognosis as the wound is usually clean with minimal associated ocular damage. The tract of entry of the FB into the eye can usually be traced easily making the localization and removal of the IOFB easier.

f) Location of the FB – FB in the anterior chamber, lens, vitreous cavity have a better prognosis than intraretinal or subretinal FB, or a FB embedded in the ciliary body or sclera.

g) Single vs multiple FB – a single IOFB definitely has a better prognosis.

h) Associated trauma to ocular structures such as lenticular disruption, vitreous hemorrhage and retinal detachment affect the management of IOFB, as they make both localization and removal of the IOFB more difficult. Also management of the associated ocular pathology in addition to the IOFB removal is more complex and increases the surgical time.

Presence of infection is obviously associated with poor prognosis.

CMS: Preoperative visual acuity is one of the most important prognostic factors. Presence of afferent pupillary defect, large and posterior corneoscleral laceration, large IOFBs, IOFB damaging disc and macula, associated endophthalmitis and retinal detachment are some of the poor prognostic factors.

PMS: Better pre-operative vision, absence of associated endophthalmitis, relative afferent pupillary defect or retinal detachment, small foreign body, small entry wound, absent lens damage and anterior / corneoscleral entry are associated with better visual prognosis. Blast injury, large / posterior entry wound, lens injury, dense vitreous haemorrhage, endophthalmitis, presence of relative afferent pupillary defect, large irregular foreign body and retinal detachment are associated with poor visual prognosis.

**RB: How common is Endophthalmitis with RIOFB?**

AK: Approximately 6.9% - 10% of RIOFB’s are associated with Endophthalmitis (as per the study done by Thompson et al. (JT Thompson, Parver LM, Enger CL, Mieler WF, Liggett PE, Infectious Endophthalmitis after penetrating injuries with retained intraocular foreign bodies. National Eye Trauma System. Ophthalmology. 1993 Oct; 100(10):1468-74). At our Centre, approx. 20% incidence of Endophthalmitis in IOFB eyes has been observed. The infection is usually fulminant and outcomes guarded, despite immediate vitrectomy.

BG: The incidence of endophthalmitis with RIOFB is usually high and reported to be seen in 8-13% of cases. The risk is much higher in eyes with organic IOFB or FB contaminated with soil. Metallic FBs are usually sterile due to the heat generated on their surface because of their high kinetic energy. As the most commonly encountered FBs in our practice are usually metallic, we have experienced a much lower incidence of endophthalmitis in our cases.

CMS: Reported incidence varies between 5-30%. With availability of better antibiotics and early primary wound closure the incidence of endophthalmitis seems to be less. Most common causative organisms are Gram positive bacteria (Staphylococcus & Bacillus sp). Gram negative bacteria & fungus account for small percentage of cases. Fungal infection is commoner if the foreign body is wooden or injury in agricultural background.

PMS: Literature quotes 2-30% patients of RIOFB can have associated endophthalmitis and 43% of traumatic endophthalmitis cases may have a RIOFB.

**RB: When do you plan for vitrectomy in RIOFB?**

AK: Vitrectomy is never an emergency, in cases of RIOFBs. The primary wound should be repaired on an emergency basis. Intra -vitreal injection of antibiotics should be administered if waiting is more than 24 hours. Early vitrectomy within 3 days prevents endophthalmitis and related damage, including fibrosis around the FB. Delayed vitrectomy after 3 days has several advantages like occurrence of PVD, decreased uveal congestion & improved media clarity.

BG: With advancement in surgical endeavour, the current trend is to remove all foreign bodies irrespective of its nature if detected early. All cases with a RIOFB in the posterior segment will require vitrectomy for its removal except for eyes within an inert FB or an old metallic FB with irreversible metallosis. After proper evaluation the goal of vitrectomy in these cases is to clear media opacities, remove vitreous scaffold, remove IOFB, remove posterior hyaloid and identify and treat all retinal breaks and RD.
Opinion regarding timing of vitrectomy differs. Those who believe in early vitrectomy (within 72 hrs) do so because it can be combined with primary repair and then prevent severe inflammatory changes and fibroglial proliferation. However, this surgery is usually in an inflamed eye and is associated with significantly higher incidence of vitreous hemorrhage and hemorrhagic choroidals. Inducing PVD is also difficult.

Most of us do this surgery after 72 hrs but preferably within 14 days. Primary repair and suitable antibiotics and anti-inflammatory drugs help to quieten the eye during this watching period. The delay helps in better diagnostic evaluation and surgery can be done under more controlled situation. Occurrence of spontaneous PVD is an added advantage.

CMS: Usually intervention is planned within a week.

PMS: I would prefer to do a vitrectomy for IOFB removal at the earliest / at presentation provided

a. Watertight wound closure and globe integrity can be achieved by primary wound suturing thereby allowing vitrectomy – if this is not possible, primary wound repair and subsequent RIOFB removal after wound healing.

b. Wound of entry is unlikely to interfere with visualization for vitrectomy – if corneal wound would allow implantation of a temporary keratoprosthesis and watertight closure and the ensuing corneal opacity will subsequently need penetrating keratoplasty, prompt IOFB removal with the aid of a keratoprosthesis can be attempted. If not, need to wait for cornea to clear after primary repair prior to attempting IOFB removal.

c. Associated injuries are not life threatening or need urgent attention

If IOFB removal is deferred, the patient should be covered with systemic and topical antibiotics prior to and after primary wound closure to decrease the risk of endophthalmitis. If the patient presents late with RIOFB in a quiet, healed eye wherein there is no urgency to removal of the RIOFB, removal can be delayed.

RB: Do you routinely apply Scleral encirclage (240 band) during Vitro Retinal surgery for RIOFB removal?

AK: A scleral encircling band is not routinely required in cases of RIOFB. However, we usually place one in the presence of retinal detachment, retinal breaks and also sometimes in phakic patients.

BG: In our practice, we don’t apply scleral encirclage during vitrectom-retinal surgery in all our patients operated for RIOFB removal. Cases with intravireal FB without any retinal pathology are usually not given a scleral encirclage. In our opinion, the role of scleral encirclage in patients with a RIOFB planned for a vitreo-retinal procedure is limited to eyes with retinal breaks and retinal detachment with associated PVR changes.

CMS: No, not routinely. An exception would be RIOFB in a Phakic patient especially if associated with a retinal detachment, as removal of anterior vitreous in these cases would be incomplete.

PMS: Not routinely unless the entry or exit wound involves the vitreous base region.

RB: How do you manage foreign body impacted in the ciliary region?

AK: Ultrasound biomicroscopy (UBM) is the investigative modality of choice for foreign bodies impacted in ciliary region. Using high-frequency (50 MHz) sound waves, we are able to create high-resolution, 2-dimensional cross-sectional anterior segment images to a depth of 5 mm which aids us in the exact location and planning of our surgery. We remove such FB’s if magnetic by direct sclerotomy over the FB site and use of a hand-held external magnet. If non-magnetic, limbal route is employed after lensectomy, and IOFB Diamond dusted forceps are used to pull out the FB.

BG: Detection of ciliary body FB has been made easier with the advent of CT scan and UBM. However, its removal is difficult because of its anterior location and increased vascularity. Approach through the scleral route is not practiced by and large because of non-availability of giant magnet and uncontrolled nature of the surgery. Intravitreal approach is difficult and needs sacrificing the lens, heavy indentation, difficult vitreous skirt removal and higher incidence of iatrogenic breaks and intraocular hemorrhage. Visibility in this peripheral area also remains an important issue. The advent of endoscopic vitrectomy takes care of this important issue and there remain no blind spots to observe ciliary body, peripheral retinal tears and other pathological changes. Foreign body removal also is more controlled and predictive.

CMS: Crystalline lens has to be sacrificed even if clear to facilitate good visualization of the ciliary region. Endoscopic removal has also been described and seems a good option for removing these foreign bodies. UBM is a very good diagnostic tool in finding and localizing these foreign bodies.

PMS: Transcleral removal would be a preferred option if impacted in to the ciliary body. Scleral cut down and employing a magnet would aid its removal.

RB: What is the ideal time for removal of RIOFB? What findings in the history and examination of such patients help you to decide the time of removal?

AK: Timing of surgical IOFB removal depends on varied factors. Early removal within 3 days enables us to
minimize complications such as endophthalmitis. However, delayed surgery, allows for improved visualization and the possible development of a spontaneous vitreous detachment. Elements such as zinc, iron, steel, aluminium, nickel and vegetative matter are highly reactive and should be removed within 3 days after localization. Inert elements such as gold, silver, and platinum can be observed if there is no evidence of infection or structural disruption. Glass though inert can be traumatic to the posterior segment structures as it has sharp edges, and removal can be equally difficult due to inherent risk of the glass FB slipping from the grasp of an IOFB forceps. PFCL usually will never float up a FB and it sinks down onto the retina.

**BG:** To re-emphasize, the ideal time for removal of RIOFB is usually as early as possible. Readily accessible anteriorly located IOFB may be removed in single sitting. However, removal of RIOFB from the posterior segment may be deferred for 1-2 weeks to allow for:

a) Clearing of ocular media for better retinal evaluation and localization of RIOFB

b) Healing of the wound and decreased ocular inflammation and congestion, hence less risk of intraoperative bleeding.

c) Spontaneous PVD to occur, making vitrectomy easier.

In the presence of infection, early removal of the RIOFB with vitrectomy should be done to control the infection, obtain samples and administer intravitreal antibiotics. Early removal of RIOFB should also be done in high risk cases for infection.

**CMS:** The timing would depend on the presence of endophthalmitis, corneal status, type and location of foreign body. If there is endophthalmitis, with no view of the fundus, an early surgery would be planned and FB would be removed during the same sitting. If there is a corneoscleral laceration associated with RIOFB it is better to do the primary repair and defer IOFB removal for a few days (5-7 days) to reduce the risk of intraoperative haemorrhage and facilitate better and more complete vitrectomy.

**PMS:** Ideal time to remove RIOFB is at presentation of the patient / within 24 hours of trauma, to decrease the risk of endophthalmitis. The situations wherein one may defer immediate removal of RIOFB are detailed in answer 5.

**RB:** Which instrument do you prefer for extraction of metallic RIOFB and for non–metallic FB?

**AK:** Anterior chamber foreign bodies can be removed through a shelved limbal or corneal incision via either IOFB forceps if it is nonmagnetic or IO magnet if magnetic. This is followed by the reconstruction of the anterior segment. Removal of posterior segment foreign bodies is aided by IOFB forceps or IOFB magnet. An external hand held ocular magnet is often required to assist in getting it out finally through the sclerotomy. Forceps with active aspiration, magnet with active aspiration, foreign body extractor with snare and sleeve have also been described.

**BG:** For extraction of a magnetic metallic RIOFB, we use an intraocular rare earth magnet as it allows a more controlled removal of the RIOFB. However, before exiting it from the pars plana port, it should be held with an intravitreal forceps and then removed. Intravitreal forceps are also used for extraction of all other RIOFBs, i.e. non-magnetic metallic FB and non-metallic FB.

**CMS:** Combination of Endomagnet and FB forceps is used for metallic foreign body. FB forceps is used for non metallic foreign body. Self retaining Chandelier illumination is often used during FB removal. It helps in getting a good grip on the foreign body and aligning it such that a smaller opening can be made for FB removal with least chance of losing the foreign body while coming out from the sclerotomy. Always err on the larger size in making this sclerotomy.

**PMS:** Intraocular magnet and foreign body forceps for magnetic foreign bodies and foreign body forceps aided by suction from cutter / flute needle or by employing another forceps to remove non magnetic foreign bodies.

**RB:** In cases of metallic foreign body which present late and are already showing signs of siderosis, what makes you decide for or against surgery to remove the IOFB at that time?

**AK:** Clinical evaluation including accurate projection of light, IOP if low suggests poorer outcomes and could be post-inflammatory or secondary to phthisis setting in. The standard full field ERG as described by Karpe in 1957 is of great importance in diagnosis of early siderosis which include as increased a-wave and normal b-wave during the very early phase. In the second stage there is diminution of the b wave. Surgical option can be considered for removal of IOFB in the presence of good visual acuity up to stage II but under guarded prognosis. Once ERG wave is flat the prognosis is very poor in spite of removal of foreign body.

**BG:** In eyes with signs of siderosis, we record an ERG of the patient to assess the severity of damage due to siderosis. These changes may still be reversible initially upto 50% decrease in amplitude of a and b waves on ERG. Hence, such eyes may benefit from surgery to remove the RIOFB from the eye. Whereas, eyes with an extinguished response on ERG are not suited for surgery, as such extreme changes are usually irreversible and carry poor prognosis. Poor visual acuity and altered pupilary reflexes are other indicators to withhold surgery.
CMS: We should remove the IOFB in all cases. Baseline ERG should be done and patient has to be explained that siderosis may persist even after FB removal.

PMS: If the ERG is flat and patient has poor vision that is attributable to the retina, it is preferable not to remove the IOFB. If vision is good despite ERG changes or if there is progressive deterioration on ERG on serial follow-up it would be preferable to remove the IOFB. The benefit of removal has to be balanced against the risks and difficulties associated with its removal.