Management of intraorbital metallic foreign body with lateral orbitotomy and c-arm guiding surgery: a challenging case

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ABSTRACT

Introduction: Orbital trauma is an emergency condition that often occurs with increasing mobility and industry. An intraorbital foreign body is one of the traumas that occur in the orbit. An intraorbital foreign body is an entrainment of corpus alienum in the orbital cavity, either accompanied by orbital fracture or not accompanied by fracture.

Case Report: We report a 31-year-old man who suffered ocular trauma and had a rusty hammer splinter foreign body stuck in the orbital cavity of the right intraconal region. The patient was found with an initial suspicion of IOFB, but investigations with a head CT scan could not detect the presence of IOFB. The treatment of choice for this patient is a lateral orbitotomy with C-arm fluoroscopy guiding. Panuveitis occurred in the patient’s eye after the extraction of the corpus alienum was performed. Suspicion of inflammation caused by siderosis bulbi cannot be ruled out.

Discussion: Suspicion of the presence of an intraorbital foreign body can be based on several clinical symptoms and patient complaints and the presence of port d’entry through the cornea, sclera, or eye adnexa. Management of intraorbital foreign body depends on the type of foreign body, its location in the orbit and the presence or absence of accompanying complications. Lateral orbitotomy with c-arm guiding in this patient successfully extracted an intraconal foreign body using the S-Stollar Wright incision technique. Avoid ocular complications due to intraorbital foreign body retention include orbital cellulitis, chronic cutaneous fistula, optic neuropathy, extraocular muscle rupture, bulbar perforation, intracranial penetration, intraorbital arteriovenous fistula, and choioretinal atrophy.

Conclusion: The management of intraorbital foreign bodies depends on the type of retained foreign body, whether inert or non-inert/toxic. So that it can prevent patients from threatening intraorbital and intraocular complications.

Keywords: Intraorbita Foreign Body (OrbFB), Lateral Orbitotomy, C-Arm Guiding.


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INTRODUCTION

Orbital trauma is an emergency that often occurs with increased mobility and industry. The incidence of orbital and head trauma in the Netherlands is reported to reach 54,000 patients per year. In contrast, at the National Eye Center Cicendo Eye Hospital, orbital trauma involving orbital fractures reached 147 cases in 3 years. One of the traumas that can occur in the orbit is an intraorbital foreign body.

Intraorbital foreign body is a condition of the presence of an alien body in the orbital cavity, either accompanied by an orbital fracture or not accompanied by a fracture. At least one in six patients with orbital trauma has trauma with partial or complete retention of an intraorbital foreign body. This type of trauma requires serious attention because it can cause permanent damage to the eyeball, orbital structures, and even the brain, resulting in blindness. Most of the cases that occur in society are caused by accidents.

Intraorbital foreign body is one of the causes of ocular morbidity, especially in adulthood. This event generally occurs after the area around the orbit is subjected to high-velocity trauma such as a gunshot, factory, or traffic accident. Only slight trauma at low speed can cause this condition.

Intraorbital trauma is more common in males than females. Types of intraorbital foreign bodies can be distinguished into 1) metal (copper, iron, lead), 2) non-metallic (plastic, glass), and 3) organic (wood, twigs). The location and damage caused by a foreign body depends on several factors, including size, shape, composition of the object and the object’s momentum during the impact. In general, trauma due to metal and glass materials is better tolerated by the body. If it does not show complications, extraction may not be carried out if the postoperative risks are greater than the benefits obtained by the patient. Meanwhile, organic material is less tolerable and generally causes a more severe inflammatory reaction, so it needs to be extracted as soon as possible.

In
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addition, the mechanism of foreign body entry and the object's size are also factors in the extent of the injured intraorbital area.4,7

Small, high-velocity foreign bodies (high-velocity trauma) will cause small linear lacerations that are less severe than blunt foreign body trauma that penetrates the oculi and, gets trapped in the intraconal region. and inflammation of the muscles and periorbital tissues. Certain intraocular metal foreign objects can produce retinotoxic ions that destroy retinal photoreceptors and pigment epithelial cells resulting in siderosis and can trigger uveitis due to an inflammatory reaction. Copper-based foreign bodies in the intraocular can cause bulbar alkalosis.8

In addition to complications in the orbital and periorbital areas, ionization reactions and inflammation that occur in the intraocular area as a pathway for foreign bodies to enter are also one of the considerations in the management of metal foreign bodies. Most IOFB made from metal will cause alkalosis and siderosis reactions, so extracting foreign bodies through operative methods is the main choice. Radiological examinations such as plain X-ray photos, ocular ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI) can be used to detect and localize

Figure 1. Clinical photo of the patient's eye when he first came to the emergency room at Prof. Dr. IGNG Ngoerah Hospital. (A) Clinical photo of eyes patient (B) Slit lamp photo of the right eye with CVI (+) PCVI (+) and visible corneal and iris rupture and irregular pupil shape, (C) Slit lamp photo of the right eye with focal magnification at the rupture cornea and iris.

Figure 2. There was suspicion of an intraocular foreign body and bleeding from an ultrasound examination.

Figure 3. CT Scan of the Head Orbital focus showed a view at an intraconal region with metal density.

Figure 4. Slit Lamp Photo of the right eye after corneal sutured at the emergency operating room.
the location of foreign bodies and assist in the course of surgery. This is a case report about a metal-type intraorbital foreign body in a 31-year-old man trapped in the intraconal region with operative management using lateral orbitotomy techniques and C-arm guiding surgery.

**CASE ILLUSTRATION**

A Man, 31 y.o., referred to Prof. Dr. IGNG Ngoerah Hospital Denpasar with pain in the right eye after pain in the right eye after being hit by a hammer fragment 2 hours before entering the hospital. It was also accompanied by blurred vision, watery eyes, glare, and black shadows in the middle of the field of view that blocked the patient’s vision. Rubbing and washing eyes were denied. He has used levofloxacin and artificial tears eyedrops for early treatment. There was no history of systemic disease or use of glasses.

Visual acuity in the right eye was UCVA 1/60 PH NI, and the left eye was 6/9 PH 6/6. Intraocular pressure on the right eye was 3 mmHg, and the left eye was 11 mmHg. Anterior segment examinations were Conjunctival Injection (CVI), Pericorneal injection (PCVI), full-thickness corneal rupture, and diagonal shape at 9 until 12 o’clock, and the size was 7 mm. The anterior chamber was shallow, VH1, vitreous (+), Iris irregular with oval pupil shape and iris rupture at 9 until 12 o’clock, the size was 5 x 2 mm, direct pupil reflex (+), indirect pupil reflex (+), Relative Afferent Pupillary Defect (RAPD) (-), Cloudy Lens (+), especially around the trauma.

Evaluation of the posterior segment found that the vitreous was difficult to evaluate, the fundus reflex was positive, and the fundus details were difficult to evaluate. There were no obstacles to the eyeball movement.

The supporting examination with
Ocular Ultrasonography (USG) on the right eye with a probe directed inferiorly found an echogenic vitreous cavity, high reflectivity, moderate mobility, retina-choroid-sclera impression of discontinuity, so it was concluded from ultrasound that there is a suspicion of vitreous opacity due to an intraocular foreign body.

Based on the examination, the patient was temporarily diagnosed with Blunt Trauma of Ocular Dextra with a complication: Full thickness Corneal rupture + Iris Rupture + Traumatic Cataract + Vitreous Prolapse + Suspect IOFB with Birmingham Eye Trauma Terminology System (BETTS) mixed type degrees D (4/200 to light perception), pupil negative (without RAPD), and zone I.

Due to the suspicion of an intraocular foreign body, further investigation was carried out with a CT scan to ascertain the location of the metal foreign body. The patient was planned to repair full-thickness corneal rupture +/- Iris repair + Anterior Vitrectomy under General Anesthesia, and then he was consulted by the Cataract Refractive Surgery Division and Vitreo-Retinal Division for IOSB management. The patient was given Cristaloid infusion 20drops/minute, Human Tetanus Immunoglobulin (IM) Injection, Ketorolac injection, Ceftriaxone Intravenous, Levofloxacin eye drop hourly on the right eye, Prednisolone Acetate and Artificial tears eye drop 6x1 OD on the right eye.

CT-Scan examination of the orbital focus: a) foreign bodies with metal density on intraconal region which seemed to be attached to the lateral side of the optic nerve and lateral rectus muscle of the right eye accompanied by retroorbital emphysema, b) No Fractures were seen in the orbital wall and bones – visualized bone, and c) presence of retention in the left maxillary sinus and deviation of the nasal septum (Figure 3).

The Vitreo-Retinal Division suspected a patient with IOFB and planned the elective management of the patient for Pars Plana Vitrectomy + IOFB evacuation under general anesthesia. IOFB evacuation measures should be carried out not more than 2 weeks after the onset of the incidence. The retinal division is planned to repeat USG after repair of full-thickness corneal rupture +/- iris repair (+) anterior vitrectomy. At the same time, the Cataract Refractive Surgery Division agreed to plan a pro-repair full-thickness corneal rupture under general anesthesia in the emergency department operating room (figure 4).

After the primary corneal suture procedure, the patient was diagnosed with a post-repair right eye full-thickness corneal rupture + iris rupture + traumatic cataract + vitreous opacity ec susp IOFB D.0 + intraconal corpus allienum (metal). The patient continued therapy with injection of ceftriaxone 1 x 2 gram (IV), ketorolac 1 x 30 mg (IV), P-pred eye drops 6 x 1 OD, Cyclon eye drops 3 x 1 OD, Lyteers eye drops 6 x 1 OD, Levofloxacin eye drops hourly OD. The patient was treated for 1 day at Prof. Hospital. Dr. IGNU Ngora then went to the polyclinic the next day, and the control plan returned to the eye polyclinic to be consulted by the Reconstructive Oculoplasty and Oncology Division.
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The patient returned on November 27th, 2020, complaining of minimal postoperative pain, blurred (+), and red eyes. Ophthalmological examination found visual acuity in the right eye 1/300, palpebral edema (+) spasm (+), conjunctiva was found with CVI (+), SCB (+); minimal (+) corneal edema with intact sutures and no leakage at the suture site; anterior ocular camera obtained VH3 with cells (+2)/ flare (+2), air bubbles (+); iris irregular, rupture (+), mid-dilated pupils; cloudy lens (+); vitreous to RF funduscopy (+) details are difficult to evaluate. Intraocular pressure 6 mm Hg. Eyeball movement was obtained well in all directions (figure 5). The patient was diagnosed with traumatic cataract OD + post-repair corneal rupture full thickness Day-4 + vitreous opacity ec susp IOFB. The patient is planned for lens mass extraction + IOL with general anesthesia.

The patient underwent a repeated ultrasound to confirm IOFB in the right eye. The ultrasound results showed vitreous opacity with high reflectivity, suggesting IOFB and a differential diagnosis of vitreous bleeding (figure 6).

The patient returned to the ROO Division on November 30th, 2020, bringing the results of a CT scan from Sanjiwani Hospital Gianyar. At the time, the patient’s visual acuity was 1/300 in the right eye, 6/9 and 6/6 with a pinhole in the left eye. Eyelid spasm and intact corneal sutures, Descemet fold with edema, and an attached contact lens bandage; the iris appears to be ruptured at 9 – 12 o’clock, and the pupil is dilated due to pharmacological agent; cloudy lens, posterior segment was difficult to evaluate and intraocular pressure 9 mm Hg.

The CT scan examination showed a hyperdense lesion (999.2 HU) in the right intraorbital, measuring 0.59 x 0.94 cm with a distance of ± 12 mm from the right optic nerve, metal foreign bodies density in the right retroorbital, and parenchyma brain within normal limits (Figure 7).

VR Division evaluated the patient and concluded, according to the CT scan, which did not show any other intraocular hyperdense lesions, the results of the examination from the VR Division suspected that the picture of vitreous opacity shown by the ultrasound results tended towards bleeding rather than an IOFB, so the VPP plan from the Retina Division was canceled, and the patient was followed up. Extraction of the intraorbital alienum corpus by the ROO Division.

On December 1st, 2020, the patient returned to the KBR Division. Ophthalmological examination found right eye vision 1/300, palpebral edema (+) spasm (+), CVI cornea (+) PCVI (+), corneal suture (+) intact edema (+), Descemet fold (+), basic contact lens (+), anterior chamber deep (+), iris irregular, iris rupture (+), pupil mid-dilation on pharmacology, cloudy lens, posterior segment red reflex (+) with unclear appearance of the segment, IOP of 6 mm Hg. The patient was then observed for 1 month to wait for the corneal suture recovery. Patients then 1 drop of Levofloxacin every 4 hours a day, 1 drop of Prednisolone-acetate every 6 hours a day, and 1 drop of Cyclopentolate every 8 hours a day.

On December 10th, 2020, surgery was performed on this patient with the S-Stallard Wright incision technique under general anesthesia. This technique is made using a scalpel blade according to the markers, a blunt dissection is performed to separate layer by layer until the periorbita passes through the intermuscular septum both above and below the lateral and posterior rectus muscles from the equator of the eyeball which provides access to the retrobulbar space. Guidance C-arm was used during the operation to identify the position of the metal foreign body, and it was found at the right lateral intraconal (Figure 8). Post-operative diagnosis of this patient was post orbitotomy lateral + extraction of foreign body (shard of the hammer) on day 0 + post repair full thickness corneal rupture + iris rupture + traumatic cataract + vitreous opacity et causa suspect hemorrhagic. Patients were given oral ciprofloxacin tablets, tranexamic

Figure 12. A photograph of the patient’s right eye at 4 months follow-up shows a rusty spot on the iris.

Figure 13. The anatomical structure of the orbital space.12
acid and gentamicin eye ointment.

After the corpus alienum was successfully extracted, suturing and reattaching the orbital rim bone with 4.0 absorbable monofilament thread was carried out in the hole that had been made on the orbital rim, followed by suturing the periostium with the same size thread. The subcutis layer was also sutured with vicryl 6.0 thread to close the incision area, after which skin suturing was performed with vicryl 7.0 following the S shape of the incision that had been made (Figure 9).

Post-operative diagnosis of this patient was post orbitotomy lateral + extraction of foreign body (shard of the hammer) on day 0 + post repair full thickness corneal rupture + iris rupture + traumatic cataract + vitreous opacity et causa suspect hemorrhagic. Patients were given oral ciprofloxacin tablets, tranexamic acid and gentamicin eye ointment.

The patients return to the Orbital Oncology and Ophthalmic Plastic Surgery Division for routine postoperative evaluation. On the 33rd day after surgery, the patient could open his right eye. The vision of the right eye is still blurred, the pain in the operating area is no longer felt, the right eye is said to have glancing difficulty in a temporal direction with visual acuity 1/300, ptosis and cicatricial eyelid, conjunctival vascular and pericorneal injections are minimal, sutures on the cornea, irregular iris with suture on, mid-dilated pupil with no light reflexes, cloudy lens, fundoscopic red reflex is present with inferotemporal, temporal, and superotemporal inhibition were found on the right eye. The intraocular pressure of the right eye was 6 mm Hg.

Objective examination of ptosis found MRD1 (+1 mm), MLD 6 mm, FPH 33 mm, FPV 7 mm, Lid crease 9 mm, Levator action 11 mm, Lid lag (-), Bell's phenomena (-). At the same time, ptosis examination of the left eye found MRD1 (+4), MLD 4 mm, FPH 33 mm, FPV 12 mm, Lid crease 9 mm, Levator action 17 mm, Lid lag (-), Bell's phenomenon (+). Patients were given 8 mg of Methylprednisolone twice a day, a single drop of Artificial tears every 3 hours for 6 times a day, and other therapies, according to the Cataract and Refractive Surgery division.

In March 2021, the patient returned for control and complained that the right eye was blurry (+), a black shadow blocked the left eye, and the right eyelid seemed to droop more than the left eye. Ophthalmological examination found VA LPBP.

The patients returned in the 5th month after the procedure in April 2021 and found the condition of the left eye with LPBP vision (1/300 in previous examination), cicatricial eyelid, ptosis (+), CVI (+), corneal cicatricial (+) diagonal at 9 o'clock -12, Neovascularization (+), deep anterior chamber (+), cell (+2) flare (+1), Iris synechiae (+) 9-12, NV (+), cloudy lens (+), Fundus RF (-), IOP 2 mm Hg, ocular motility is obstructed superolaterally, laterally, and inferolaterally.

Examination of ptosis of the right eye revealed MRD1 (+2), MRD2 (5 mm), MLD 5 mm, FPH (31 mm), FPV (7 mm), LC (8 mm), LA (12 mm), Bell's phenomenon (+). Patients were referred to the Immunology Division (IIM), as well as 1 month of control for evaluation of traumatic ptosis. The patient was also diagnosed with panuveisit by ultrasound results showing opacity due to inflammation and bleeding in the vitreous of the right eye. Medication of a single drop of Prednisolone-acetate every 3 hours a day, a single drop of Levofloxacin every 6 hours a day, a single drop of Artificial Tears every 3 hours a day, a tablet of 16 mg Methylprednisolone twice a day. The next evaluation will be in 2 weeks.

The patient was then examined at the Strabismus Division and diagnosed with acquired esotropia ec inflammation suspected of abducens nerve lesions. The patient had an esotropia impression of 15º and kramsky 30 PD BO, force duction test of superior and lateral restriction, and force generation test resulting in a paresis on the lateral rectus muscle.

In month 6, patients were found in visual acuity of NLP, IOP 3 mmHg, heterochromia, rubecosis iridis, decreased pupil reflexes and response, lens opacities and vitreous opacity (figure 12). IIM Division had diagnosed patients with panuveis, corneal scarring, rubecosis iridis, and traumatic ptosis with post-lateral orbitotomy (6 months). The patient was then consulted back to the VR Division.

The VR Division planned for the patient to undergo an intracameral Bevacizumab injection followed by a second intracameral injection 1 month after the first injection. Visual condition of the right eye of the NLP patient with cornea scarring, NV (+) sliced at 1, 2 and 10 o'clock, heterochromia, traumatic cataract of the lens, IOP 2 mmHg, and RF after the injections. Lens extraction and evaluation from the KBR Division were planned, but the patients preferred to refuse the surgery.

DISCUSSION

Intraocular foreign bodies is an accidental injury that often occurs in cases of work accidents or military activities. Intraorbital trauma can cause structural and functional damage depending on the type and location. Diagnosis is based on clinical symptoms and patient complaints (decreased vision, pain, and diplopia). On physical examination, port d’entry can be found. The decision is based on the size and type of foreign body, the location of the intraorbital foreign body, and complications such as NI II compression, infection, and extraocular muscle involvement. In this case, a young adult male patient had a nail splinter foreign body that entered the right eye through the corneal at a high velocity to the intraorbital. The main complaints are pain in the right eyeball, decreased vision, and redness of the eye. Based on the examination, it was found that the foreign body of the nail splinter was in the intracanal space.

Based on the anatomy, the orbital cavity is bounded by the roof of the orbit, the lateral and medial walls, and the floor of the orbit. Most of the thin portion of the orbit with a thickness of <0.5 mm lies on the medial wall and infraorbital canal, which is the roof of the maxillary sinus and floor of the orbit. The lateral portion of the ethmoid sinus, the lamina papyracea, is the thinnest of the medial orbital wall. Based on its relationship with the extraocular muscles, the region is divided into globe, intraconal, conal, and extraconal/peribulbar. The volume of the orbit in an adult is approximately 30 cm³ and the eyeball occupies only about one-fifth of the cavity with fat and muscle making up the bulk. The division of the
orbital space and CT-scan images make it easy for the operator to determine the location of the foreign body and decide the surgical technique that needs to be used.

Radiological examination is important in cases of suspected intraocular or intraorbital foreign bodies. Ultrasound of the orbit is necessary to eliminate the presence of intraocular foreign bodies. Conventional radiography and CT scan of the head that focused on the orbit are the top choices for foreign bodies made of metal (69% - 90%) and glass (71% - 77%), but their detection rate is low in foreign bodies made of wood and organic materials (0% - 15%). Supportive examination with Magnetic Resonance Imaging (MRI) is an option for non-inert organic materials such as wood, plants, or metal materials <0.5 mm. This is because CT scans can produce false negative conditions.

The patient came with a visual acuity of 1/60 in the right eye, then decreased to 1/300 on the next follow-up. This visual condition lasted for about 3 months and then progressively decreased from LPBP to NLP. The patient's condition is classified as an open globe injury type of perforation based on the Birmingham Eye Trauma Terminology (BETT) accompanied by the presence of a non-inert intraorbital foreign body. Perforated type ocular trauma due to a rusty hammer splinter that enters at high speed, penetrates the cornea to the posterior sclera, and gets trapped in the intraconal space. Rusty iron foreign bodies can leave rust remnants intraocularly, especially in the vitreous, retina, choroid, and posterior sclera.

In this case, the intraocular foreign body was extracted, but vitreous hemorrhage and inflammation (panuveitis) still occurred which was quite difficult to treat even though the patient had received eye drops and systemic corticosteroids. The possibility of ocular siderosis in this patient is low due to residual rust or fine iron flakes that were left behind cannot be ruled out with certainty because the visualization of the posterior segment is covered with cloudy media (ruptured iris, traumatic cataract, vitreous opacities). Investigations with an ultrasound B scan showed vitreous turbidity which was treated as bleeding from IOFB, a CT scan cannot be used as a gold standard in this condition. Moretti et al. 2012, stated that the CT scan modality can produce a false-negative condition in foreign bodies with a size of <0.5 mm.

Ocular siderosis occurs because of iron material that is retained in the intraocular for a period of time. This process made the interaction of trivalent ions with intraocular proteins. The form of ocular siderosis manifestations can be anterior and posterior uveitis, moreover panuveitis. Other clinical signs include heterochromia, mydriasis, cataracts, lens subluxation, glaucoma, vitreous opacity, photoreceptor degeneration, exudative retinal detachment or RPE and papillae atrophy. Misdiagnosis is quite common in cases of ocular siderosis until showed signs of inflammatory manifestations in the form of panuveitis.

Management of foreign bodies can be pharmacological or surgical intervention. All patients with suspicion of IOFB should be given anti tetanus prophylaxis 0.5 ml intramuscularly. Patients with organic-type intraorbital foreign bodies need to be given broad-spectrum antibiotics to cover aerobic and anaerobic microorganisms. Surgery intervention for the extraction of non-inert materials such as wood, copper, and plant matter must be carried out immediately especially if they are present in the COA. Foreign bodies that are inert, have smooth edges, and are located in the posterior orbit are better tolerated. Non-reactive metallic foreign bodies, such as iron, tin, stainless steel, and aluminum, can be left in the orbital cavity because they are well tolerated. However, iron and copper have a high risk for siderosis and alkalosis which induce purulent inflammation. Foreign bodies such as metallic bullets, as in this case study, are toxic particles that must be extracted immediately.

Complications that may occur due to the retention of intra orbital foreign bodies include orbital cellulitis, chronic cutaneous fistula, optic neuropathy, extraocular muscle rupture, ocular perforation, intracranial penetration, intra orbital arteriovenous fistula, and choriretinal atrophy. Inorganic intra orbital foreign bodies were found in 79% of cases and 54% were made of metal.

Extraction of the intra orbital foreign body in this case was performed by a lateral orbitotomy approach with C-arm guiding. Orbitotomy is performed to access multiple intra orbital soft tissue compartments. There are two orbitotomy approaches to the orbit including a) anterior orbitotomy with superior, inferior, and medial approaches and b) lateral orbitotomy. The choice of this approach is determined by the location of the foreign body and the purpose of the operation itself.

In this case, the metallic IOFB was trapped in the intraconal space 0.12 cm lateral to the optic nerve, posterior to the equator, so the lateral orbitotomy technique was the right choice. The 2 lateral orbitotomy incision techniques are Berke-Reese and S-Stallard Wright. Wright’s S-Stallard technique was chosen to minimize postoperative scarring that can affect the lateral canthus postoperatively. The use of C-arm guiding was used because the location of the intra orbital foreign body was intraconal so there were difficulties in detecting the position of the foreign body during surgery. Excessive manipulation without guiding causes more damage to surrounding tissue structures. The use of intra orbital C-arm guiding provides direct (real-time) visualization and makes it easier for the operator to see the position of instruments and foreign objects in the orbital cavity, to assist the extraction process.

CONCLUSION

Intraorbital foreign bodies occur because foreign objects enter and get trapped in the orbital cavity. Detailed anamnesis and ophthalmological examination as well as radiological examination are needed in making the diagnosis. The type, location, and related complications are the main considerations in the management of surgery or analysis. Lateral orbitotomy can be performed to extract foreign bodies that are posterior and lateral to the optic nerve. The use of a C-arm fluoroscopy guide is one of the tools that make it easier to find foreign bodies and reduces complication.

CONFLICT OF INTEREST

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