INTRAOCULAR FOREIGN BODIES

RETAINED IN THE POSTERIOR SEGMENT

CLINICAL FEATURES, MANAGEMENT OPTIONS AND

PROGNOSTIC FACTORS

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To describe mode of management of posterior segment intraocular foreign body (IOFB) injuries and identify prognostic factors for visual outcome.

INTRODUCTION

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Penetrating ocular injuries associated with intraocular foreign bodies (IOFBs) constitute a significant proportion of eye trauma requiring urgent medical and surgical attention. The first report of intraocular foreign body was made as early as **1891 by Critchett**. The foreign body isolated being a fingernail.

Doyne in 1894 reported a foreign body being present in the lens for thirty years. **Cunningham** who reported an intraocular foreign body during the war in **1916**. Several types of foreign bodies were reported in between, like pieces of whiplash by **Hutchinson in 1889.**

The most serious problem is the resulting impairment of visual function. Recent advances in vitreoretinal surgical techniques and in fabrication of microsurgical instruments have played an important role in reducing complications from IOFBs by facilitating their early removal and treating severe injuries even with low OTS and poor preoperative BCVA.

Despite these advances, it continues to present a bewildering array of management decisions and IOFBs continue to take their toll through the injury they cause initially in the process of penetrating the eye. Of eyes with penetrating injuries, approximately 18 to 40% are found to harbor at least one IOFBA high index of suspicion for an IOFB is therefore essential in all penetrating injuries for appropriate, emergent referral and workup. Efficient and thorough evaluation prior to proceeding with surgical intervention helps maximize the chances for visual recovery. With appropriate and timely management, many patients achieve acuities of 20/40 or better.

There are several factors which determine the final prognosis of these patients with posterior segment IOFB. Such factors individually or in association with several other variables decide both anatomic and functional success of these patients.

Functional success

According to" Ryan and Allen" functional success is defined as preoperative VA of light perception or hand movements improved up to at least 5/200 (according to Snellen chart) or improvement of two lines in those eyes with preoperative Snellen acuity.

Anatomic success

Good anatomic outcome has been defined as an attached retina during the follow-up period.

Significance of predictive factors

Predictive factors of visual outcome and anatomic outcome could aid the clinician in choosing appropriate surgical and medical management of IOFB trauma and in counseling the patients

Variables/factors can largely be divided into two subsets

1. Variables independent of intervention at the time of initial presentation E.g.: Presenting visual acuity ,Length of wound ,Type of PSIOFB Location of PSIOFB, presence of vitreous hemorrhage etc

2. Variables dependent on intervention

   E.g.: Management of retinal detachment, Time of primary wound repair

REVIEW OF LITERATURE

REVIEW OF LITERATURE

INTRAOCULAR FOREIGN BODY-TYPES AND EFFECTS [2]

A thorough knowledge of the type of foreign body, whether metallic or non metallic, organic or inorganic helps in evaluating the patient's condition and predicting his final visual outcome. Basically foreign bodies are of two types, metallic and non metallic.**(Chart 1 & 2)**

INTRAOCULAR FOREIGN BODY-TYPES

Table 1

Metallic		
Magnetic	**Non Magnetic**	
Iron and Steel	Inert	Irritative
	Gold	Copper
	Silver	Lead
	Platinum	Mercury
	Zinc	
	Aluminum	
	Brass	

Table 2

Non Metallic			
Organic		**Non Organic**	
Animal	Vegetable	Inert	Irritative
Cilia	Cotton	Sand	Stone
Caterpillar Hair	Wood	Concrete	Talcom Powder
		Coal	
		Gun Powder	
		Glass	
		Quartz	

IOFB is magnetic in 89% of cases [(2)]

Clinical picture

Von Hippel in 1896 described widespread pigmentary degeneration following intraocular foreign body in 1896.Experimental studies on the action of lead foreign bodies on the eye have been undertaken by **Leber (1881-91), Rolland (1887)** and **Valois (1902).**The clinical composition of the copper foreign body was further exemplified. **Jess (1919-30)** considered that the metal is in the form of carbonate while Vogt in 1931 considered that it was an oxide of copper.Pyogenic infection, as a result of vegetable foreign body and the resultant exudative inflammatory response was first described by **Raab in 1875**.

Entrance of a foreign body into the eye may cause damage to the eye in three ways;

1. By mechanical effects depending on its shape and size.[2]
2. By introduction of infection. [2]
3. By specific action of the foreign body.[2]

SPECIFIC EFFECTS

- A foreign body can remain in the eye without exciting any inflammatory reaction indefinitely. A case report by **Fejer in 1932** in which the first evidence of inflammation arose 20 years after the injury.**Punnonen and Laati-kainen** also described that inert IOFB remained within the eye without causing any reaction. **Grunthal in 1895**, **Cohen in 1929**, described that a foreign body can remain in the vitreous chamber without exciting any reaction for months or years.

- In case of intraretinal foreign body, the point where the particle becomes impacted into the retina, tissue reaction is excited in the neighbouring retina and choroid is usually considerable, so that the foreign body becomes encapsulated. This ophthalmoscopical picture was first described by **Jager(1857) and Von Graefe(1857)**

Reaction of ocular tissues to a foreign body varies according to their inherent chemical nature.

Inorganic materials:

a. inert
b. excite a local irritative response which leads to the formation of dense fibrous tissue.[7]
c. produce a suppurative reaction.[2]
d. cause specific degenerative effects.[2]

Organic materials:

Produce a proliferative reaction characterized by the formation of granulation tissue. Although inert materials cause little or no reaction at the time of injury, but iridocyclitis and disorganization may eventually develop.[2]

IRRITATIVE METALS

Experimental studies on the action of lead foreign bodies on the eye have been undertaken by **Leber (1881-91), Rolland (1887)** and **Valois (1902).**

Lead [2]-It is one of the commonest form of intraocular foreign body, and the most inert, because it is rapidly covered with a layer of insoluble carbonate which prevents its diffusion and chemical reactivity. It produces few changes in anterior chamber and has no effect on lens liquefaction and opacification of the vitreous gel can occur. If the metal lies on the retina or choroid, it causes an exudative reaction, partly purulent and partly fibrinous.

Mercury [2]-This metal provokes a purulent inflammation in the eye. Cornea undergoes necrosis and there will be purulent inflammation in vitreous.

Metallic

Iron and copper are two of the commonest foreign bodies found and both undergo electrolytic dissociation and are widely deposited throughout the eye causing important toxic and degenerative changes.

Iron [2]-Amongst all foreign bodies, clinically those of iron and steel deserve special mention. The clinical picture of siderosis bulbi was first described by **Von Graefe in 1860.**In **1980; Keith M. Zinn et al** described the mechanism of visual loss when an iron foreign body was impacted on the optic nerve head.

The foreign body releases ferrous ions and saturates the binding apoferritin molecules, thus excess of free unbound ferrous ions interfere with specific vital intracellular electron transport systems and thus causes optic atrophy.

The typical sequel to the presence of an iron foreign body is "siderosis bulbi". In contrast to a copper foreign body, there is no immediate violent reaction; however the delayed chemical effects of iron upon the ocular tissues are much more harmful because they set up a chronic degenerative process.

In addition to siderosis as sequelae, six other developments may occur;

1. No apparent reaction due to complete encapsulation.(2)
2. A piece of encapsulated foreign body may shift its location after several years and cause violent inflammation.(2)
3. It can cause recurrent inflammation with episodes of hypopyon and recurrent iridocyclitis, ending in shrinkage of the globe.(2)
4. Spontaneous expulsion from the globe can occur. (2)
5. A small foreign body may occasionally dissolve away completely. (2)
6. Sympathetic ophthalmitis can occur.(2).**Welder (1948)**, described a sympathetic uveitis developing after a lapse of 30 years in wooden IOFB

Siderosis (2)-The clinical picture first described by **Von Graefe in 1860**. It is a reaction caused by an iron foreign body in the eye. Extent of damage caused to the eye varies with the size and position of the foreign body in the eye. The worst location is in the ciliary body or the posterior segment of the eye, when it is non-encapsulated. An iron foreign body carries a better prognosis in the anterior chamber and the best prognosis when it is in the substance of the lens. Iron from intraocular foreign bodies is mostly deposited in the epithelial tissues such as iris sphincter and dilator muscles, the non pigmented ciliary epithelium, lens epithelium and the retinal pigment epithelium. These iron deposits are revealed by Prussian blue reaction, using Perl's mirochemical stain. Oxidation and dissemination of ferric ions occurs throughout the eye initiating the "Haber-Weiss" reaction. This results in the formation of powerful oxidants such as hydroxylradicals, superoxide and hydrogenperoxide, which cause lipid peroxidation, sulfhydryl oxidation and depolymerisation leading to enzyme inactivation and cell membrane damage.

During the process of siderosis, the foreign body becomes absorbed to some extent occasionally may completely disappear. Thus a retinal foreign body loses its metallic sheen and may become negative for x-rays.

Two forms of siderosis exist ;[2]

Direct siderosis [2]**-**It occurs when iron gets deposited in the immediate neighborhood of the F.B. It starts immediately after lodgment of the foreign body.

Indirect siderosis [2]-It occurs when the metal gets diffused throughout the tissues of the eye.

- The differentiation of direct and indirect siderosis was made by **Burge** in **1890**

The effects of siderosis on the various structures of the eye are the following;

Cornea [2]-A rusty staining of the corneal stroma is seen.

- **Coaf’s white ring:** the iron deposits are found at the level of the Bowman's membrane.

Trabecular meshwork [2]-Secondary open angle glaucoma due to iron deposition in the trabecular meshwork.

Iris [47]-Heterochromia with posterior synechiae can occur.

Pupil [2]-Mydriasis with poor reactivity may occur, which could be due to atrophy of the muscle fibres of the sphincter and dilator pupillae which are histologically heavily impregnated with iron.

Mechanism [2]-The damage occurs probably due to electrolytic dissociation of the metal in the eye which disseminates it throughout the tissues and enables it to combine with cellular proteins, killing the cells and causing atrophy of the tissues.

Lens [2]-Initially iron can be deposited in the form of brownish dots lying subcapsularly on the anterior capsule of the lens. Later diffuse peppering beneath the anterior lens capsule becomes aggregated into large rusty brown patches.

Vitreous [2]-Degeneration of the vitreous can occur.

Choroid [2]-Changes occur only when degeneration is far advanced.

Retina [2,3]-In the retina, siderosis can cause several changes like;

1. Pigmentary degeneration, producing a secondary retinitis pigmentosa.
2. Arteriosclerotic changes
3. Optic disc discoloration and atrophy and

4. Retinal detachment

Copper [3]- Retention of a copper foreign body causes "chalcosis" [13]. Reaction varies with the content of pure copper. If the metal is pure it causes a violent reaction, suppurative in nature with catastrophic consequences. If copper is alloyed to another metal with a final copper content of less than 85%, chronic chalcosis results. The metal tends to disseminate widely throughout the tissues of the eye producing the characteristic picture of chalcosis.

- The description of changes of chalcosis dates back to **1892** and the first person to mention it was **Priestley Smith**, who noted the peculiar retinal appearances following retention of copper foreign body in the posterior segment.**Purtscher (1918)** was the first to give a detailed description of the slit lamp appearances of sunflower cataract.

Pathology-Copper may cause;

1. Proliferation of fibrous capsule and encapsulation of the foreign body
2. Suppurative reaction with the formation of an abscess
3. A chronic nongranulomatous inflammation, the inflammatory infiltrate consisting of degenerated polymorphonuclear leucocytes and a few macrophages
4. Copper becomes electrolytically dissociated and gets deposited in various ocular structures producing typical Chalcosis. Copper gets deposited in limiting membranes. This can be detected by

histochemical stains like modified p-dimethylaminobenzyl rhodamine or rubeanic acid.

Chalcosis [(2)]**-**characterized by the following due to the oxide of copper; [(2)]

a. A greenish blue ring in descemet's membrane of the cornea- "Kayser fleisher ring". This ring starts in the periphery of the descemets membrane, separated from the limbus by a clear zone.
b. Multiple metallic particles in the aqueous humor, which are brightly refringent and greenish brown in color.
c. A greenish discoloration of the iris.
d. Deposition of copper on the anterior lens forming the so called "sunflower cataract". The pupillary area is occupied by a thick powdery deposit located underneath the anterior lens capsule. When the pupil is dilated spokes from it run like petals of a flower towards the periphery of the lens fading out before reaching the equator of the lens. Very occasionally a second ring concentric with the first appears near the periphery.
e. Impregnation of the zonular fibres.
f. Brownish red vitreous opacities.
g. Brilliant deposits like tiny pieces of gold leaf on the retinal surface and metallic flecks on the retinal vessels and in the macular region.

The clinical course of chalcosis varies and usually develops after a lapse of several months. Progressive deposition of the metal with slow dimunition of vision occurs. The prognosis with copper IOFB is good because copper does not enter into chemical combination with the proteins of the cells, hence degenerative changes do not appear and the visual prognosis is good.

Inert materials

Aluminum [(2)-]Any tissue on contact with the metal develops a grey necrotic imprint. It frequently becomes powdered and excites an intense local reaction.

Zinc [(2)]**-** It produces a very minimal reaction when it is pure and sterile. In the posterior segment, the inflammatory reaction is associated with retinal atrophy.[(12).]**Lauber in 1913** first described a zinc foreign body getting impacted on the retina.

Others (Inert IOFB [(2)]

Gold, Silver, platinum, Glass, plastic, stone

Removal of inert materials can be done several days after primary repair as a part of a secondary procedure. Punnonen and Laati-kainen [(4)] found no significant difference in outcome between those IOFB injuries managed within 1 week to those removed several weeks after the initial insult.

EFFECTS CAUSED BY ORGANIC MATERIALS [(2)]

Organic materials like wood and vegetable matter may cause endophthalmitis sympathetic ophthalmitis, vitreous abcess and intraocular cysts requiring urgent surgical removal within 24-hours without delay.

In rural communities, farm injuries are responsible for a significant proportion of IOFBs.

Caterpillar hair produces granulomatous nodule known as ophthalmia nodosa[2]

Mechanisms of Injury [1, 2]

IOFBs lodged in the posterior segment are typically small metallic fragments that have a so-called knife-edge. Generated most frequently by pounding metal against metal, such as by hammering or by high-speed grinding, drilling, or explosions. In fact, nearly 70 to 80% of such injuries are associated with hammering a chisel, nail, or stone. These sharp-edged particles acquire sufficient speed to penetrate the anterior segment structures easily, coming to rest in the posterior segment. In contrast, blunt objects such as BBs require a great deal of momentum to penetrate the eye. They impart far greater concussive force on the eye and result in more generalized damage to critical intraocular structures, even without penetration. Nonmetallic objects, which generally are larger and more blunt, may also impart much greater impact on the eye in the process of penetrating the posterior segment. This mechanism may help explain the poorer outcomes after injury with nonmetallic IOFBs.

In case of intraretinal foreign body, the point where the particle becomes impacted into the retina, tissue reaction is excited in the neighbouring retina and choroid is usually considerable, so that the foreign body becomes encapsulated [2]

The IOFB can usually be found in the posterior segment (58%).70% of eyes with a posterior segment perforation became blind compared with only 20% with an anterior segment perforation.[2,18]

Classification of mechanical injuries

Type of injury defined by the mechanism of injury; [1,19]

1. Rupture
2. Penetrating
3. Intraocular foreign body
4. Perforating
5. Mixed

Grade of injury defined by visual acuity ; [1,19]

1. (>0.50)
2. (0.40-0.20)
3. (0.19-0.025)
4. (0.02-light perception)
5. (no light perception)

Zone of injury defined by the location of the wound [1,19]

1. (isolated to cornea)
2. (limbus to a point 5 mm posterior into the sclera
3. (posterior to the anterior 5mm of sclera)

Relative afferent pupillary defect

Rupture; [1, 2, 19] -Rupture is a full-thickness wound of the eye wall, caused by a blunt object.

Penetrating [1, 2, 19]-Penetrating injury implies a full-thickness entrance wound.

Perforation [1, 2, 19]-Perforating injury entrance and exit wound of the eye defines perforating injury. A sharp object can cause both of them.

Intraocular foreign body

- The phenomenon of rebounding foreign body from the posterior wall of the eye was first demonstrated by **Berlin (1867-68)**
- **Williams and colleagues** and **Behrens-Baumann** and **Praetorius**, found that the posterior segment foreign bodies were found to be intravitreal in 76%, intraretinal in 19%, and sub retinal in 6% of the cases.

Intraocular foreign body injury has retained foreign object in the eye. A study showed functional outcome depended on Zone and RAPD and did not depend on Type of injury [(19)]

Anatomic outcome depended on RAPD, RD and did not depend on Endophthalmitis, zone, or type.

In contrast patients who had worked with soil-contaminated tools developed a posttraumatic infectious endophthalmitis. [(6)]

MECHANICAL INJURIES CAUSED BY IOFB's [(1, 2, 3)]

a. Conjunctival tear
b. Scleral tear
c. Corneal tear- Location of IOFB is corneal in 65% of patients
d. Iris hole
e. Iridodialysis
f. Subluxation and dislocation of the lens
g. Rosette cataract and other traumatic cataracts
h. Retinal tears and hemorrhage

i. Retinal dialysis
j. Retinal detachment
k. Choroidal tear and hemorrhage
l. Vitreous hemorrhage
m. Vitreous base avulsion
n. Vitreous incarceration
o. Optic nerve avulsion

DIAGNOSIS AND LOCALIZATION

Diagnosis of the presence of IOFB is frequently a matter of considerable difficulty. If the particle is small, its presence may be completely unsuspected. Very little pain may be caused by the entrance of the foreign body into the eye, and the incident may be totally disregarded by the patient and it may not be until years have elapsed that its presence is proved by the development of siderosis or chalcosis.

Therefore in all cases where an IOFB is reasonably suspected, care should be taken to exclude its presence. The detection and localization of IOFB is thus very important and demands techniques capable of greatest accuracy.

Diagnostic methods are grouped into two methods; [1, 2]

1. Clinical methods for direct visualization of the foreign body.
2. Special methods for indirect visualization of foreign body.

A detailed and proper history should be taken as it gives an important clue about the nature of the foreign body and the ocular damage. The following points are to be noted;

a. Occupation of the patient at the time of injury.
b. Circumstances leading to the injury.
c. Instrument with which the patient was working at the time.
d. Information regarding force and direction of the missile.

DIRECT EXAMINATION

Slit lamp examination

Is done to detect

1. wound of entry
2. associated corneal, scleral or iris tear
3. penetrating tract in the lens or vitreous
4. angle trauma with peripheral anterior synechiae and angle recession.

Slit lamp biomicroscopy of the anterior vitreous is also important to demonstrate any vitreous strands towards a hidden scleral rupture. Evidence of vitreous degeneration and opacification also should be looked for. Any signs of siderosis or chalcosis should be looked for.

Indirect ophthalmoscopy-Examination of the posterior segment of the eye under full mydriasis should be done by indirect ophthalmoscopy if media is clear. Exact position and nature of the foreign body, trauma to the disc and macula can be assessed.

Transillumination (diaphanoscope) [(2)] - It may occasionally provide important evidence. If the foreign body is very large and opaque and is situated in the anterior half of the eye, transcleral diaphanoscopy may reveal its presence. Similarly indirect diaphanoscopy by transmitted light from the nasopharynx when the fundus is examined simultaneously with the ophthalmoscope may be of value if the foreign body is opaque, quite large and situated in the posterior half of the globe.

- The procedure of trans scleral diaphanoscopy was first described by Leberin 1902 and Sachs in 1903.Indirect diaphanoscopy was first described by **Hertzell in 1908**.

INDIRECT EXAMINATION

When the ocular media is clouded by hyphaema, cataract or vitreous hemorrhage, ancillary techniques are necessary.

The following methods are used;

1. Those depending on magnetic ability of the foreign body.
2. Those depending on electrical conductivity and induction.
3. Those depending on chemical analysis.
4. Radiological methods including CT scan and MRI.
5. Ultrasound.
6. Electroretinogram.

Methods depending on magnetic ability of the foreign body (2)

- Magnets have been frequently used as a diagnostic instrument to determine the presence of a foreign body within the eye. This method was first described by **Mckeown (1876)** and **Pagenstecher (1881).Pooley in 1880-81** was the first to apply this principle.

Formerly, magnets were used as a diagnostic instrument to determine the presence of foreign body within the eye. When a powerful magnet is applied to a globe containing a magnetic foreign body, the latter is drawn towards the pole of the magnet. Instruments using this principle are Gerard's magnetometer and sideroscope.

Limitations

1. Not recommended for use now because even a small movements of the foreign body in uncontrolled conditions may be harmful.
2. If the foreign body is encapsulated, no movement may occur and a negative result is by no means conclusive.
3. Causes severe pain and damage to ocular structures due to movement of the foreign body.
4. It is useful only for magnetic foreign bodies

Thus this method is not used presently.

Methods depending on Electrical Conduction-Metallophone [2]

- A method depending on the electrical conductivity is the basis of the metallophone of **Weiss (1906)**
- **Comberg in 1933** devised the radioamplifier to localize a magnetic foreign body.

The principles of these methods depend on the fact that if an alternating current is sent through a primary circuit, a current is induced in the secondary circuit. If voltage in the secondary coils are equalised then no current flows between them. If at this stage, when an instrument approaches a metallic foreign body, the balance inductance is disturbed and a difference in potential is created in the secondary circuit resulting in a flow of current, which alter amplification is recorded by the deflection of a voltmeter needle. Amount of this deflection depends on the size and magnetisability of the foreign body.

Various instruments using this principle are;

1. Berman's locator
2. Roper hall's locator
3. Camay's locator
4. Ophthalmometalloscope of Hale

Berman's locator-It is used for detection of magnetic foreign body. The detecting range for magnetic foreign body is ten times the diameter of the foreign body i.e. 10 mm for a foreign body of 1 mm size. For nonmetallic foreign body, it ranges between 1-2 times. Non magnetic IOFB can be detected only if they are greater than 3 mm in diameter. The sensitivity of a Berman locator to nonmagnetic metals is directly proportional to the electrical conductivity of the metal.

Roper Hall's locator-It is also called as the electro acoustic metallic foreign body locator. The response given by this instrument for ferrous metallic foreign bodies is continuous, while for non-ferrous metals it is intermittent.

Advantages of locators are;

1. They are small and portable.
2. They do not need any expert technicians.

3. They can be used during surgery to confirm the position of the foreign body.

Methods based on radiographic techniques [(2)]

- **Velter (1919)** described a method of localization whereby two lead pellets as markers were sutured onto the limbal conjunctiva and x-rays were subsequently taken.
- Method of bone free localization of an intraocular foreign body using dental films was first described by **Vogt (1927).**
- Diagnostic x-ray spectrometry is a new method for noninvasive detection of trace elements in the human body. This method was described by **Ron Neumann et al in 1992**.It measures the amount of metallic dissolution in eyes with intraocular foreign bodies. Extraction of the foreign body was recommended based on the amount of metallic dissolution.

All metals are radio-opaque. Ordinarily, a metallic fragment of 0.5 mm diameter will be evident on x ray films.

Radiographic methods are useful in different ways;

1. Demonstration of a hitherto invisible foreign body
2. Exact localization of the foreign body.

Various methods used are

A. **Direct Methods**

Initially - PA and lateral views are taken.

The position of the foreign body is then located in relation to a radio-opaque marker bearing a known relationship to the globe. Types of markers that are used may be lead pellets, silver rings or contact lenses fixed to the globe.

Limbal Ring Method [(2)] - Metallic ring of diameter, 11-14 mm is sutured to the limbus. Then two radiographic views are taken;

- Limbal ring localization of an intraocular foreign body was used by **Stallart (1944)** and **Somerset (1947)**.

a. A.P.A. view with the eyes looking straight ahead.

b. lateral view

Precautions:

1. Image of the ring on PA view should be circular.
2. Image of the ring on lateral view should be vertical and not elliptical. Measurements and Interpretations:

1. On PA view - The center of the ring formed by the limbal ring is marked. A schematic eye of 24 mm diameter is drawn from the center. If the foreign body falls within the schematic eye it is intraocular, otherwise it is extraocular. A vertical corneal axis is drawn passing through the center of the ring and the distance of the foreign body nasal or temporal to this vertical corneal axis is noted and measured.

2. On lateral view-A line formed by the image of the ring is bisected and a line is drawn at right angles back from it forming a horizontal corneal axis. Distance of the foreign body above or below this axis is also noted and the distance of the foreign body from behind the limbal ring is also noted.

To measure the A.P. measurement from the front of the cornea, 3mm should be added to the measurement from the limbal ring. Finally the position of the foreign body is charted on Bromley's chart or Crideland's graticule.

The Crideland's graticule is used for taking measurement directly from radiographs. It is photo etched on the underside of a glass plate so that it can be placed in direct contact with the film.

Limitations of the test

1. Errors may arise from the movement of the ring and inaccuracy of its fit to the limbus.
2. Inaccurate orientation of the globe can be present during its use.
3. The ring cannot be sutured to a badly damaged eye.
4. Standard eyeball size is taken as 24mm which is not always true even in emmetropes.

Contact Lens Method [(2)]- This method was first suggested by Fox and was perfected by **Comberg**. It utilizes a contact lens with radio-opaque markers. The markers actually touch the eye thereby reducing the error of radiological magnifications.

- **Fox in 1902**, introduced an oval insert of gold with cross wires into an anaesthetized conjunctival cul-de-sac and localized the foreign body in PA and lateral exposures with reference to it

- **Comberg** elaborated this technique who made use of a Zeiss contact lens with lead markers at four different quadrants.

CombergTechnique-A zeiss contact lens with lead markers in four quadrants is used.

Worst Lovac Contact Lens- This contact lens is held in constant position during filming by a partial vacuum produced between the contact lens and the corneal surface.

Disadvantages of contact lens method

1. It is assumed that the eyeball is 24mm long.
2. Superimposition of contact lens markers on the image of the foreign body cut occur.
3. It is an additional trauma to the eye.
4. Improper positioning of the contact lens can occur due to chemosis and a deformed anterior chamber.
5. Sometimes a poor contact lens fit will allow movement of the lens, so the limbal reference marker distance might not be accurately located on the films.

Contact lens application is contraindicated when there is-

1. Severe corneal laceration
2. Marked lid swelling
3. Excessive corneal edema

B. **Methods depending on rotation of the globe** [2]

In these methods, the head and the X-ray tube remain fixed, while several photographs art token with the eyes moving in different directions. Usually 3 exposures in lateral view with the eyes looking straight, upwards and downwards are taken. If a foreign body lies anterior to the centre, there will be movement of the foreign body in the direction of ocular motion. If the foreign is intraocular or closely attached to the posterior wall of the globe, it moves with the eye and its rotation will centre on the centre of rotation of the eyeball.

If it is extraocular, it will not move a foreign body with the globe need not necessarily be intraocular. Extraocular foreign body embedded in the tenon's capsule, extraocular or orbital fat may move in relation to ocular motion.

Limitations

1. There is no true centre of rotation of the globe.
2. The calculations are made in reference to a schematic eye of 24mm, this giving an error.

C. **Methods depending on geometric construction**

Sweet's Method; [2] - In this method, the patient's head and the eyes are fixed. Two metal indicators are used one pointing exactly on the centre of the cornea, and the other at a known distance from the first on temporal side. Two exposures are taken, one with the X-ray tube in the same horizontal plane as the indicators, but at a slightly lateral angle so that the shadow of one is thrown farther forward on the screen than the other. A second exposure is taken from a position below this plane, so that the shadows of the indicators appear separately.

Direction of the x-rays could be graphically represented by measuring the displacement of the indicators on each film and the position of the foreign body.

- Mackenzie and Davidson devised methods based on geometric construction. The first geometrical method to be published was devised by **Sweet in 1897**.

Advantages

1. No contact with the eye.
2. The radiological image of the marker is not superimposed on the image of the foreign body.

Limitations

1. A possible error of 24mm in Sweet's technique is a disadvantage.
2. Difficulty in maintaining fixation.

D. Stereoscopic methods [2] - This method depends on liking two stereoscopic pictures at two fixed angles and listing the position of the foreign body from the displacement of its shadow with reference to a known radio-opaque marker.

- Stereoscopic methods of localization were described by Griffin and **Goldberg in 1943**.

E. **Methods involving the delineation of the globe using contrast media**

- Methods involving the delineation of the globe by injection of air was first described by **Staunig in 1927**

Attempts are made to outline the contour of the globe by injecting air or radio opaque material into the Tenon's space with a view to differentiate whether the foreign body is within or without the globe. This method overcomes the error caused by the schematic eye. The radio opaque dyes used are Thorotrast and Lipoidal etc.

Disadvantages of this method:

1. Air embolism if air is used.
2. Tissue reaction to the dye.

F. Bone free method [(2)]-This method is also known as Vogt's method. It is particularly useful if the foreign body is in the anterior segment of the eye, in small foreign bodies or metallic foreign bodies in the anterior chamber, the density of which equals that of the bone. It is also valuable in determining the size and the shape of the foreign bodies that have been localized on film exposed in the regular way.

Procedures:-An ordinary dental film is held over and perpendicular to the inner canthus of the eye of the patient and the rays are directed from the side so that a shadow of the profile of the anterior segment of the eye is recorded on the film. This method is useful only for localizing fragments in the anterior 8-12 mm of the eye. This procedure may also be used to localize a foreign body by directing rays from different angles on to dental films marked with parallel lines aligned with the limbus.

Computed tomography **[2]-** (CT) [2] with fine, 2-mm cuts through the orbit should be obtained. This technique can localize foreign bodies as small as 0.7 mm in one dimension. CT is particularly helpful for localizing most IOFBs, as they often are radiopaque, although small non-metallic fragments and fragments too close to the sclera may occasionally be missed. Careful examination of the scan is essential to avoid missing multiple foreign bodies, as may be the case in approximately 20% of eyes

- C.T. scanning -**Kollarits et al in 1977** revolutionized the method of C.T. scanning for the detection of intraocular foreign body with the help of third and fourth generation C.T. scans, and found that this method of investigation was uniformly convenient and atraumatic to the patient, besides being accurate.
- Limitations of C.T. scans in the localization of intraocular foreign body was described in a study conducted in **September 1984 by Harvey Topilow et al.** Foreign bodies situated in the scleral wall or embedded in the retina are difficult to localize by C.T. scanning.

Ultrasonography [1, 2, 3] - It provides complementary information regarding the anatomy of the traumatized globe. The presence of retinal and choroidal detachment can be readily obtained. If performed skillfully and gently to avoid the extrusion of intraocular contents from an open globe, ultrasonography can be performed on some eyes to detect IOFBs that may be missed by CT.

Fundus visualization of traumatized eye can be obscured by hyphema, cataract or vitreous hemorrhage. Ultrasound examination of the posterior pole is imperative in such cases to detect any intraocular damage and the presence of a foreign body.

Principles:

It consists of propagation of high frequency sound waves through the soft tissues with differential reflection of these waves from objects in the path of the beam. These are received by the transducer. The information received is recorded on an oscilloscope. Thus ultrasound can accurately localize a foreign body with a systematic approach providing transverse and longitudinal views in all meridians.

The two forms of ultrasound used are the A mode and B mode.

A Scan:-It is a one dimensional method. It may reveal an orbital foreign body immediately posterior to the sclera. The foreign body signal appears as a steeply rising echospike.

B Scan:-It gives a two dimensional picture and is more valuable than A scan, if the foreign body is in the sclera. An intraocular foreign body appears acoustically white (opaque). This echogenic opacity contrasts with the acoustically clear vitreous.

Quantitative echography of an IOFB (a special technique):

The reflectivity of foreign body echospike is extremely high reaching 100%. This special technique of quantitative echography allows a comparison with the scleral signal.

Advantages of USG:

1. Can detect a foreign body even in the opaque medium.
2. Can detect the presence of associated retinal detachment and vitreous hemorrhage.
3. Gives us the axial length of the eye ball.
4. Can localize non - radio opaque foreign bodies.
5. Can precisely localize intraocular or extraocular foreign bodies.

Advantage - Even at low field strength foreign bodies are visible. M.R. scanning uses higher field strength and are likely to give higher resolution images and allow thinner slices which would improve detection and localization. However there is a distinct risk of torsional forces being applied to a ferromagnetic foreign body causing intraocular complications. M.R.I. is found to be superior to C.T. scanning in evaluating plastic foreign bodies.

Electroretinogram: [1, 2, 3]-In siderosis bulbi early E.R.G. changes include increased amplitude of the "a" wave and a normal "b" wave. Late changes include diminished "b" wave amplitude and ultimately an extinguished E.R.G.

In chalcosis E.R.G. shows initially an increased "a" wave amplitude and later a decreased Wave and "a" and a "b" wave amplitude.

Magnetic resonance imaging (MRI) [2] MRI however, generally should not be used in screening for the presence of an IOFB as movement induced by the magnet may lead to additional intraocular trauma. However, once the magnetic properties are known, MRI may be useful in further assessment-

- M.R.I. scanning was first suggested by **Lauterber in 1973**.

. **MANAGEMENT**

Ultimate visual recovery of a patient with an intraocular foreign body depends on prompt and optimal clinical management.

In all cases of retained intraocular foreign body prognosis is always guarded. In some cases, a patient having good vision at the time of the accident may lose vision subsequently owing to complications that develop either as a consequence or a delayed effect of the intraocular foreign body.

Clinical management depends on: [1, 2, 3, 4, 8, 9]

1. Accurate localization of the foreign body.
2. Composition, size and shape of the foreign body.
3. Precise assessment of the extent of damage to the eye.
4. Decision to remove the foreign body or not.
5. Decision to enucleate the eye or not.

The following are the management modalities employed:

REPAIR OF ANY ASSOCIATED INJURIES

First and foremost the structural integrity of the globe should be assessed and restored. Any associated scleral or corneal tear if present must be repaired.

A simple corneal laceration without any tissue incarceration should be closed with 10-0 nylon interrupted sutures. Scleral tears should be repaired with 8-0 or 7-0 non absorbable sutures such as vicryl.

If iris is incarcerated in the wound, it can be reposited in most cases. Excision of the uveal tissue is done only if it looks extremely necrotic, having been externalized for more than 24 hours.

Sometimes vitreous may also be extruded through the scleral laceration and it should be cut flush with the sclera.

Management of intraocular foreign body

- **Julius Hirschberg in 1900** revolutionized the management of intraocular foreign body, by being the first to apply electromagnet.

When the patient has a metallic foreign body it is useful to determine if the IOFB metallic or not. Magnetic foreign bodies were removed by magnets. Magnets used in ophthalmic surgeries;

1. Hand held magnet
2. Giant magnet
3. Intraocular magnet

Hand held magnet [(2)]-It is small in size and low powered. It is applicable only when the IOFB is within anterior vitreous.

Giant magnet or Electromagnet [(2)]

Electromagnets are more powerful and may be used both extraocularly and intraocularly. The disadvantage of these magnets is that careful orientation of the magnet is required. Otherwise, they can lead to impaction of the foreign body into intraocular structures or damage from the foreign body being pulled across these delicate structures.

The working criteria for a giant magnet [1, 2, 3]

The basic principles governing the distribution of magnetic field follow Coulomb's law (H = MM'Id2, where M and M' are the strength of the magnet at each pole, and d refers to the distance between the poles). Furthermore, the field decreases proportionately to the distance of an object from the magnet. Therefore, the strength of a magnet is inversely proportional to the cube of the distance. The dramatic fall-off in magnetic strength with distance means that powerful magnets are needed to act even over a short distance. This characteristic affords one major advantage in that objects align themselves along their long axis, thereby facilitating removal

The rule states that to be effective giant magnet should pull a steel ball of 1mm diameter with a force of over 50 times its own weight at a distance of 20mm.

Since almost 90% of the IOFBs are magnetic, the success rate with EM use has been high - as long as success is defined as removal of the IOFB. The discrepancy between successes in IOFB removal versus in visual outcome is explained by several factors.

Disadvantage of EM [1, 2, 3]

1. The magnetism of a metallic IOFB is directly related to its iron content.

2. A magnetic foreign body orients itself longitudinally to the magnet, a change of orientation can be damaging if it occurs near the retina.
3. Strength of the magnet decreases as its distance from the foreign body increases, the magnetic force being inversely proportional to the cube of the distance.
4. The EM is unable to address common primary and secondary complications of the injury such as cataract, vitreous hemorrhage, and retinal impact site.
5. Magnet extraction seems to be a gross maneuver in comparison to controlled vitreous microsurgery, and it can also produce complications such as iatrogenic retinal tears, retinal detachments, and hemorrhage.
6. If applied prior to the formation of a strong fibrous capsule around the IOFB EMs are capable of removing ferrous IOFBs in virtually every case. Unfortunately, IOFB extraction leaves unresolved the threats concurrent intraocular tissue injuries pose. Furthermore, since the intraocular flight pattern of the IOFB remains unpredictable even if application of the EM is carefully planned, iatrogenic injuries caused by the intervention are rather common. In at least 30% of the known cases in a study done on 30 eyes in Department of Ophthalmology, **University of' Pecs, Pecs, Hungary by Viktoria Mester and Ferenc Kuhn,** EM use led to vitreous hemorrhage.
7. External magnets are bulky. The magnetic pull may be exerted over a wide area, can pull an intraocular foreign body out at high speeds and, if misaligned, may cause the intraocular foreign body to strike the eye wall or intraocular structures, with damaging effects. Magnetic

extraction with an external magnet therefore carries some risks owing to the uncontrolled nature of the procedure and the unpredictable path of the foreign body during its hoped-for exit from the eye

Posterior Segment

The management of posterior segment foreign bodies is most problematic as they are frequently associated with extensive ocular damage. The route of removal of a foreign body from the posterior segment is determined by its location, size, magnetic property and clarity of media. Attempts to remove them blindly or through the entry site is extremely dangerous.

Good visualization of the foreign body

When the foreign body is clearly visible in the vitreous cavity or on the retina, with no encapsulation, a magnetic foreign body can be successfully removed with an electromagnet after a pars plana vitrectomy. A pars plana sclerotomy can be made after repair of the site. The sclerotomy should be large enough to allow easy exit of the foreign body without incarceration in the pars plana.

Poor visualization of the foreign body

If the media is not clear due to hyphaema, cataract or vitreous hemorrhage, first of all, the foreign body is accurately localized using the limbal ring method or ultrasonography. Hence anterior chamber irrigation or a vitrectomy with a lensectomy is indicated to clear the media.

Accurate localization of the foreign body is very important in the management. This helps the surgeon to decide the type of surgery and also makes the surgery easier. Hence the prognosis depends on the localization. After localizing it is useful to determine whether the foreign body is magnetic or nonmagnetic.

- **James.S.Shipman et al** in a study done between **1943 and 1953** concluded that the anterior route of extraction was better for those foreign bodies which were 3 mm or less in greatest diameter and posterior route of extraction was reserved in those cases where the foreign body could not be extracted anteriorly or if it was more than 3mm in greatest diameter.
- A study conducted by **Nathaniel Bronson et al in 1968**, in Southampton, published in the American journal of ophthalmology, concluded that postsurgical vision after extraction of non magnetic foreign bodies was poor since nonmagnetic foreign bodies were larger and more serrated and hence tended to cause more damage.

If the magnetic foreign body is impacted in the retina and the choroid, removal options are:

1. Trans scleraly if it is located anteriorly. [1,2,3]
2. If the foreign body is located posteriorly then it is removed via pars plana sclerotomy after vitrectomy. [1,2,3]

Trans scleral route [1, 2, 3]

IOFB is localized on the sclera and a sclerotomy is created over it. Diathermy then is used on exposed choroid, and the IOFB is removed with a hand-held magnet through a choroidal incision

If the foreign body is magnetic and is located very anteriorly near the ora serrata or the pars plana, then the trans scleral removal is the easiest method. A sclerotomy is made at the site where the foreign body is localized and its position is confirmed with the help if a giant magnet. The giant magnet is then applied to the site and the foreign body is gently mobilized and removed.

Pars plana route [(1, 2, 3, 8, 11)]

- In **1972, Barry.L.Beckerman** described that immediate removal of the foreign body was likely to prevent long term retinal toxicity.
- In **1982, Gregory S. Brinton et al**, Wisconsin, reported that the visual prognosis was much better in eyes that underwent vitrectomy and intraocular foreign body removal within days of the injury.

Role of PPV

The introduction of PPV in the early 1970s offered a new approach to managing eyes with posterior segment IOFBs.   During the development of vitreous microsurgical techniques, the conventional use of an external magnet to extract metallic IOFB has become a questionable approach.

1. Primary pars plana vitrectomy is needed for the management of both a traumatic IOFB removal and treatment of tissue injuries such as media opacity and retinal lesions. In fact, the vitreous surgeon does not attempt IOFB extraction unless the media have been cleared so as to provide sufficient visual control throughout the actual removal process, and all connections of the IOFB to the vitreous and/or retina have been severed so as to prevent exerting traction on the retina (IOFB without encapsulation).

2. Removes the vitreous and blood clot scaffold that provides a framework to the visual localization of IOFB; it helps to find retinal breaks and detachments which may not be visible in the setting of vitreous hemorrhage.

4.It provides direct viewing and controlled removal of the IOFB as well as treatment of most complications, whether they occur at the time of the injury (e.g., retinal lesions) or subsequently (e.g., PVR).

5. Allows reconstruction of the posterior segment

6. Controls the healing response

7. Prevents phthisis

A vitrectomy is performed, followed by application of laser or diathermy to the retina around the impaled foreign body before its removal using an intraocular magnet

If the foreign body is non-magnetic and is located anteriorly or a magnetic foreign body is located posteriorly either in the vitreous cavity, embedded in the retina or under the retina, removal via the pars plana route is the method. Pars plana surgery offers to clear the media by lensectomy and/or vitrectomy. Thereafter the foreign body can be visualized. If encapsulated, the fibrous tissue should be cut and the foreign body is then mobilized and brought to the sclerotomy site and is removed with a giant magnet. Barrage laser or endocryopexy is applied to the impacted site.

In cases of magnetic intravitreal foreign bodies Parel's intraocular magnet is used for removal. Non magnetic foreign bodies require removal with foreign body forceps. A vitrectomy is done; the foreign body is grasped with a foreign body forceps and removed through the pars plana sclerotomy site.

With early vitrectomy performed in the first four days, retinal tears and detachment can be treated and fibro cellular proliferation can be prevented. The disadvantages are higher risk of bleeding, wound leakage, and increased difficulty to detach the posterior hyaloid and control suprachoroidal hemorrhage and bad visualization. [5, 8, 11]

There are two strong indications for delayed vitrectomy performed within 5-14 days after trauma; [50, 53, 56]

1. Choroidal hemorrhage
2. Large posterior wound in perforating open globe injury. For severe trauma with extensive damage to the eye, early vitrectomy can alter the prognosis. Early vitrectomy can lower the probability of proliferative vitreoretinopathy and retinal detachment, which are frequent in severe trauma

Disadvantage of Primary repair and IOFB removal [5, 11]

Removal of the posterior hyaloid, an important surgical goal, is difficult if performed early after injury in these young patients. Furthermore, the risk of major intraoperative hemorrhage is greater if surgery is done on an inflamed eye

Some factors, though present, might be able to be modified during the treatment course to improve outcome. For example, performing an extensive examination of the features of younger patients and why they tend to do more poorly might provide some insight on how to improve outcome in these patients. Perhaps younger patients are prone to more severe injuries that would not allow for a change in intervention. Alternatively, perhaps the physiology of the vitreous may make them more prone to RDs and proliferative vitreoretinopathy (PVR). Future directions might include considering pharmacologic vitreolysis in those patients to decrease those complications.

Removal intraretinal foreign body (1, 2, 3)

Removal of such a foreign body can be difficult and hazardous.

If ocular media is clear and the intraocular foreign body is well localized by indirect ophthalmoscopy, it can be removed trans-scleraly wherein, a trap door scleral flap is created, the choroidal bed is treated with external diathermy, choroid is incised and the foreign body is removed either with a forceps or an external magnet. If localized retinal incarceration occurs, that area is treated with localized scleral buckling.

Intraretinal foreign bodies can also be removed transvitreally particularly if visualization is poor after a pars plana vitrectomy the foreign body is mobilized with a foreign body forceps and laser treatment to the retinal penetration site is done.

Removal of sub retinal foreign body (1, 2, 3)

Usually sub retinal foreign bodies are removed after a retinotomy, following which they removed with the help of a foreign body forceps. Site of impaction is treated with barrage laser prior to removal.

Management of associated retinal tears [1, 2, 3]

There is also a great deal of controversy over optimal management of a retinal tear caused by a foreign body. It is advocated that a photocoagulation or a cryopexy is necessary at the site of impaction to create a localized chorioretinal adhesion.

But Stephen Ryan says that the inflammation caused by the foreign body impaction is adequate to prevent a retinal detachment.

If however a retinal detachment occurs at the time of extraction, it is important to remove adherent cortical vitreous prior to fluid gas exchange to reattach the retina.

Management of extremely large foreign bodies [1, 2, 3]

Such foreign bodies can pose a great difficulty for removal via the para plana route. That being the case an open sky approach may be considered

Instrument used for PPV [3]

A panoramic viewing system (BIOM, Oculus). This viewing system enables wide-angle posterior segment visualization both through a small pupil and in an air-filled eye. Sclerotomies and conjunctiva were closed with interrupted 7-0 polyglactin sutures (Vicryl).

Grieshaber or Wilson vitreous foreign-body forceps after performing pars plana vitrectomy for the removal of nonmagnetic IOFB (Magnetic IOFBs can also be removed this way.)

Vitreous cutter-25G vitrector

MANAGEMENT: [3] - Chart 3

WELL VISUALISED		POORLY VISUALISED
INTRAVITREAL		INTRAVITREAL
Magnetic-External Magnet		Vitrectomy forceps/REM
Non-magnetic-Vitrectomy/forceps		Vitrectomy/forceps
INTRARETINAL		INTRARETINAL
Magnetic-Trans-scleral "trap door"		Vitrectomy forceps/REM
	or vitrectomy, forceps/REM	
Non-magnetic	Trans-scleral "trap door"	Vitrectomy/forceps
	or vitrectomy, forceps/REM	

Management of associated complications

Despite advances in the management of eyes with penetrating injuries there still remain a large group of patients who still have a very poor prognosis due to recognition and management of associated complications.

The associated complications can be vitreous hemorrhage, retinal tears and detachments, endophthalmitis traumatic cataract iridodialysis, subluxated lens with zonular dialysis etc.

Associated vitreous hemorrhage [4, 9]

Any penetrating injury can be associated with vitreous hemorrhage, which may warrant attention.

A lot of studies have proved that doing an early vitrectomy may minimize the incidence of severe visual loss after penetrating injuries minimizing the intraocular fibrous proliferation and progressive vitreoretinal traction. It also provides visualization of the retina and identification and treatment of possible retinal detachment. Some authors believe that an early vitrectomy (i.e., within 72 hrs) decreases the risk of intraocular proliferation and obviates the need for a second surgery.

Delayed vitreous surgery (i.e., beyond 72 hrs after injury) has its own advantages. It permits further diagnostic evaluation; including U.S.G, C.T. scanning etc. and surgery can this be performed under more favorable circumstances than emergency conditions. A spontaneous separation of the posterior hyaloid may also occur during the waiting period, making the excision of posterior cortical vitreous easier. Delayed surgery tends to cause less sever hemorrhage.

Protocol followed

In cases with vitreous hemorrhage and associated total hyphaema, hyphaema can be evacuated through a limbal incision with an irrigating infusion needle inserted through a second incision. [2, 4, 8]

Secondly a decision of removal of the lens must be made, because if it is opacified, subluxed or dislocated, it will have to be removed. In most cases the lens is removed through the pars plana using either the vitrectomy probe or an ultrasonic fragmenting device. [2, 4, 8]

A trans pars plana vitrectomy is done to treat the vitreous hemorrhage along with foreign body removal. (2, 4, 8)

Associated retinal detachment

The incidence of retinal lesion is 26-68% in PSIOFB. (5, 20)

The incidence of retinal detachment before PPV is reported to be 15% to 37%.

Cause of RD in PSIOFB: (5)

Retinal detachment (RD) is a known complication that occurs as a result of the following;

- Posterior segment intraocular foreign body (PSIOFB) injury
- Surgical interventions performed to remove PSIOFBs and/or correct collateral ocular damage
- Formation of proliferative vitreoretinopathy (PVR). While the literature is replete with cases of RDs subsequent to PSIOFB injuries, few data exist concerning late postoperative, non-PVR, hematogenous retinal detachments (RRDs) after initial successful PSIOFB removal.

Penetrating ocular injuries intraocular foreign bodies are often associated with retinal detachments and retinal tears. After the anterior segment is cleared, vitrectomy can be performed easily, following which retina is carefully examined for retinal tears or detachments. If retinal tears are identified, they are treated with trans-scleral cryopexy, if peripheral and with endophotocoagulation, if posterior. All peripheral retinal breaks have to be buckled with an encircling band.

When retinal detachment is present, all tangential and anteroposterior vitreoretinal traction should be relieved on the retinal break by membrane peeling or delamination.

If the traction cannot be relieved, a scleral buckle should be placed to support the break. Sub retinal fluid should be drained transvitreally through a posterior retinal break or a posterior retinotomy created superior and nasal to the optic nerve head.

Retinal Incarceration at the site of scleral laceration can produce a difficult situation. If the Incarceration is anteriorly, vitrectomy and scleral buckling will suffice, if located posteriorly scleral buckling is difficult and trans pars plana vitrectomy with a retinotomy and fluid air exchange with perflourocarbon gas injection may be necessary.

A preoperative retinal detachment may be present in 21% of the eyes with IOFB and has been reported to be an important risk factor for poor visual outcome. The timing of surgery in these eyes for the removal of IOFBs has been found to be an important prognostic factor for better visual outcome. (52)

In the presence of a detached retina, surgical manipulations to remove the IOFB increase the risk of causing iatrogenic retinal breaks. In young patients with IOFB, removal of the posterior hyaloid which is intact may not be possible in the presence of a retinal detachment. This uncompleted vitrectomy will lead to postoperative proliferative vitreoretinopathy. Open globe injuries and retained IOFBs have a tendency to develop peripheral vitreous traction and retinal tears. The development of postoperative retinal detachment and PVR was significantly associated with preoperative retinal detachment.

Delay in treatment was mostly due

1. To late patient referral after the trauma or lack of understanding on the part of the patient

2. Lack of suspicion of IOFBs by primary care physicians. [7,9]

Endophotocoagulation or transscleral cryotherapy used to treat peroperative retinal breaks, intraocular silicone oil tamponade and gas tamponade with 16% C3F8 -perfluorocarbon and encircling band were not significantly associated with the presence of postoperative retinal detachment. [9]

Generally in young patients with IOFB, removal of the posterior hyaloid which is intact may not be possible in the presence of a retinal detachment. This uncompleted vitrectomy will lead to PVR. [54]

If a retinal break is present at the time of surgery, short-term intraocular gas tamponade may be effective in securing retinal reattachment provided the break is sealed and vitreoretinal traction has completely been relieved. Occasionally, however, a prolonged tamponade using silicone oil may be preferred if;

1. The surgeon suspects that gas tamponade may not lead to lasting retinal reattachment.
2. In eyes with excessively edematous retinas, it may be difficult to achieve effective endolaser photocoagulation of breaks. In such patients, silicone oil tamponade is useful because it limits any postoperative hemorrhage and allows immediate postoperative photocoagulation.
3. Silicone oil permits earlier visual rehabilitation and allows air travel in the postoperative period.

4. Silicone oil may also limit the access of vitreous fluid into current or future retinal breaks, and persistent inferior retinal detachments under silicone oil usually are stable, may not extend to involve the macula, and may not necessitate reoperation in all patients.

In contrast, complex retinal detachments, repaired by techniques not involving silicone oil, usually require additional surgery for progressive inferior retinal detachments. [(6)]These advantages of silicone oil must be weighed against the potential risks, including secondary macrophagocytic open-angle glaucoma, corneal endothelial cell damage with secondary bullous keratopathy, and cataract. The frequency and severity of these complications of intraocular silicone oil increase with the duration of intraocular silicone oil tamponade. To reduce the risk of these complications, it has been suggested that silicone oil be used only for a temporary endotamponade and it be removed when it is no longer of use for the attachment of the retina or the inner homeostasis of the eye. The most serious complications of the removal of silicone oil are ocular hypotony with secondary phthisis bulbi or retinal redetachment, which may occur in up to one third of the patients.

RRDs were considered "late" postoperative ones when they occurred either more than 2 months following vitrectomy without gas tamponade or when they occurred more than 2 months following the complete dissolution of vitreous cavity gas in cases treated with vitrectomy with gas tamponade.[(6)]

Endophthalmitis [(2, 7)] - It is one of the most devastating complications of ocular penetrating injury. It is seen in 2-7% of penetrating injuries. Commonest organism implicated in traumatic settings is Bacillus cereus.

A delay in intervention of more than 24-hours was associated with a risk of clinical endophthalmitis. [7]

Early vitrectomy has helped in attaining useful functional vision in 25-51% of the eyes with posterior segment trauma and in some cases help salvages eyes where it has helped in significant survival of eyes without improvement of final visual outcome. [7]

- Pyogenic infection, as a result of vegetable foreign body and the resultant exudative inflammatory response was first described by **Raab in 1875**.
- A study conducted by **Nathaniel Bronson et al in 1968**, in Southampton, published in the American journal of ophthalmology, concluded that postsurgical vision after extraction of non magnetic foreign bodies was poor. The reason behind this being the fact that nonmagnetic foreign bodies were larger and more serrated and hence tended to cause more damage.

A study conducted by **Jost.B Jonas et.al** [10] showed that a PSIOFB removal >24 hrs after trauma and type of foreign body were statistically significant predictors of poor visual acuity.

Mode of injury and age of the patient had no bearing on the development of clinical endophthalmitis.

However delayed repair of the trauma and removal of IOFB in the vitreous or retina were moderately related to poor BCVA.

He also suggested that antibiotics be administered at the time patients were first seen.

Protocol [1, 3]-The situation should be managed immediately. Intravitreal injection of a broad spectrum antibiotic like Cephezolin (2.25mg) and Gentamicin (200 microgram) or Amikacin (400 micrograms) should be administered. However B, cercus is resistant to cephalosporin and penicillin.

Currently advocated treatment regimen is:

Intravitreal injection of 400 micrograms of Amikacin with 1 mg Vancomycin end 450 mg Clindamycin. The foreign body has to be removed.

Prophylactic intraocular injection is controversial and is given only in those settings where there is a high suspicion of injury from a contaminated foreign body.

The foreign body is then cultured in a media to isolate any infectious organism. Culture sensitivity is also done and the patient is put on appropriate antibiotics.

Proliferative vitreoretinopathy [52, 54, 55]

Delay in intervention was found to be a significant predictor of the development of a postoperative retinal detachment and development of postoperative proliferative vitreoretinopathy [52, 54].Shortest interval between trauma and foreign body extraction was also found to be a significant predictor for a good final visual acuity. [7,9,10].Therefore, patients with penetrating trauma involving the posterior segment known to be at high risk for development of proliferative vitreoretinopathy are potential candidates for pharmacological and possibly also genetic treatments to prevent or minimize fibro cellular proliferation

So all patients should have an increase awareness concerning late RRDs complicating PSIOFB injuries, and

The surgeon should emphasize that long term observation should be performed until the posterior hyaloid completely separates, if it was not surgically stripped.

The experience of the surgeon may have a much greater impact on the final result than the timing of the operation. Other reports suggested a delay of surgery firstly to reduce the risk of intraoperative hemorrhage in freshly and severely injured eyes, which may be dangerous even if gas-forced infusion is used; and secondly to wait for a spontaneous detachment of the posterior vitreous which should facilitate intraocular surgery. [7, 9, 10] The "spontaneous" detachment of the posterior vitreous in eyes after open-globe injuries may, however, not occur really spontaneously because contracting forces within the vitreous may be considered to be an early stage of proliferative vitreoretinopathy. The "spontaneous" vitreous detachment several days after an open-globe injury may thus only serve to suggest that an FB might be removed as early as possible.

However, improvements in the surgical management of PVR have occurred in the modern vitreoretinal surgical era. Thus, it is still uncertain whether others reports of RDs following surgery for PSIOFB are those of PVR associated RDs or RRDs.

Late postoperative RRD in eyes that have undergone vitrectomy for PSIOFB removal is probably related to the detachment of the posterior hyaloid following injury and/or the PSIOFB removal. In our series, it was observed that posterior hyaloid separation resulted in RRD in two patients 4 and 8 months after initial injury and vitrectomy. Growing evidence supports that spontaneous, age related posterior vitreous separation is a gradual, staged event.

Prophylactic posterior hyaloid stripping performed at the time of vitrectomy for primary PSIOFB removal might prevent not only PVR, but late RRDs. This may be particularly true in traumatized eyes harboring intra-vitreal blood products, mediators of inflammation, and retinal breaks (for example, PSIOFB impact sites). Unfortunately, most PSIOFB injuries occur in young patients in whom the posterior hyaloid can be difficult to remove, especially when pre-existing retinal breaks may be present. Additionally, the risks of posterior hyaloid stripping include the creation of retinal tears and RRDs. If the hyaloid is not peeled at the time of vitrectomy, it will ultimately detach spontaneously. At the time of that spontaneous detachment, peripheral retinal breaks and RRDs may ensue

In a study conducted by **Jost B. Jonas, MD et.al** [10] showed that Minimum length of the foreign body ,maximum length of the foreign body, preoperative visual acuity, presence of a retinal lesion, traumatic cataract were statistically significant factors in PVR development.

Associated Cataract [1, 3, 8]-Management of cataract after penetrating injuries is controversial. Cataract can be better managed if its removal is deferred because it then permits the intraocular inflammation and the fibrin reaction to clear and the status of the lens zonules can also he accurately assessed.

If the decision is made to remove the lens the choice is between lensectomy and extra capsular cataract extraction, with or without an intraocular lens implantation. If the zonules are intact, cataract extraction via the limbal route can be done. If the lens is subluxated or dislocated it is removed by pars plana lensectomy or via the limbal route after using perflourocarbon liquid.

Incidence of Traumatic cataract is 44% to 66.6% of cases with IOFB. [(8)]

When large lacerations involving both anterior and posterior lens capsules are present, pars plana lensectomy using a vitreous cutter or ultrasonic fragmentation is often used to remove the traumatic cataract. [(8)]Deferral of primary IOL implantation is advocated. If the capsule defect is small and the cataract precludes fundus visualization, cataract extraction and primary IOL implantation during vitreous surgery for IOFB removal is an attractive option, allowing rapid visual rehabilitation after a single surgical procedure.

Aphakia resulting from cataract extraction during vitreoretinal surgery is often very difficult to correct. Aphakic glasses are unacceptable because of predominantly monocular aphakia. [(8)] Contact lenses are often difficult to fit because of keratopathy, corneal scars, or pronounced postoperative conjunctival scarring. [(8)]

Secondary IOL implantation could be performed subsequently, as soon as a stable anatomic situation is achieved, but requires a second surgical procedure. [(53)]

Late complications-

1. Fibrotic membranes due to organization of residual lens matter or inflammation, development of pupillary membranes are regarded as late complications.

2. Sympathetic ophthalmia [1, 2, 3] -A bilateral, granulomatous inflammation of the uveal tract, characterized by a nodular or diffuse infiltration of lymphocytes and epitheloid cells. Inflammation appears in the injured eye within 4-8 weeks. Sympathizing eye becomes involved simultaneously or shortly thereafter. Evidence suggests that the risk of sympathetic ophthalmia is extremely low if the injured eye is enucleated within 2 weeks of injury. Treatment of choice is systemic corticosteroids.

Other late complications include “siderosis" and "chalcosis".

Treatment of siderosis

Surgical-First and foremost prompt removal of the foreign body.

Medical

- Galvanic deactivation
- Administration of intravenous E.D.T.A.
- Subconjunctival injection of adenosine triphosphate.
- Administration of desderrioxamine, which tags the free ions and converts it to non-toxic chelate.

Treatment of Chalcosis

Medical

1. Sodium Thiosulphate, 2.Sodium hyposulphate, 3. B.A.L.

PATIENTS AND METHODS

MATERIALS AND METHODS

Design

This was a prospective, noncomparitive interventional case series conducted at the retina department Joseph Eye Hospital, institute of ophthalmology, Trichy.

Procedures

Records of patients with PSIOFB seen between January 2007 to June 2009 were reviewed for clinical characteristics, surgical intervention, and outcome.

20 Eyes of 20 Patients with posterior segment intraocular foreign bodies were included in this study. Various data were collected and documented

Main outcome measures

Final best corrected visual acuity

Inclusion criteria

Confirmed presence of retained posterior segment foreign body.

Removal of PSIOFB with or without additional procedures

Follow up of minimum 6 months.

Exclusion criteria were;

- Anterior segment foreign body.
- Intralenticular foreign body
- Scleral IOFB, and eyes with double scleral perforations

- Patients with magnetic PSIOFB with follow up< 6 months
- Orbital foreign body
- Foreign bodies associated with severe globe injuries and disorganization of the globe.
- Patients who did not undergo IOFB removal

A detailed history was taken based on various factors and history regarding any previous treatment was also taken. This was followed by a detailed clinical examination

A physical assessment was done to note any other bodily injury.

Localization of PSIOFB

If the media was clear, a detailed indirect ophthalmoscopy was done to locate the foreign body and to assess the status of the vitreous, retina and choroid at the earliest.

X-ray orbits were taken in PA and lateral views to confirm the presence and find out the nature of the foreign body

Ultrasound B-scan was done to confirm the presence and to localize foreign body in the posterior segment in eyes with hazy media.

CT scan was done where it mattered

Data on Patient demographics

- Age and gender
- Eye involved
- Cause of the trauma (Injury mechanism)

- Preoperative visual acuity (VA): Best corrected visual acuity (BCVA) was determined with the Snellen E chart.
- Time elapsed between injury and presentation at our institution

IOP recording-Because of the laceration, intraocular pressure was not measured

Data on IOFB

- Slit lamp examination was carried out on all eyes without the use of a contact lens
- Number, type, and size
- Location of foreign body

Data on the results of external and slit lamp examination

- Site of initial laceration, i.e., Entrance wound location
- Wound size
- Uveal prolapse
- Traumatized iris
- Hyphema
- Lens injury
- Endophthalmitis
- Vitreous prolapse
- Vitreous hemorrhage
- Retinal tear/RD
- Macula involvement

Preoperative Imaging of the involved eye

- B-scan
- X-ray orbit
- Computerized axial tomography

Details of surgical procedures

- pars plana vitrectomy with IOFB removal
- Pars plana lensectomy/Regular cataract extraction through sclera wound with or without IOL implantation
- Endolaser photocoagulation
- Retinocryopexy
- Silicon oil injection
- Fluid gas exchange with C3F8 implantation
- Scleral buckling
- PVR management
- Evisceration/Enucleation

MANAGEMENT

1. Wound repair and Pars plana IOFB removal

Tetanus toxoid was administered and broad-spectrum antibiotics started in all patients upon admission (Oral Cephalexin 500mg three times daily).

In cases suspicious for endophthalmitis, intravenous Vancomycin in conjunction with ceftazidime and or Amikacin was given.

Two surgeons performed all PPV with PSIOFB removals and subsequent RRD surgeries under general anesthesia.

Surgical management consisted of repair of the laceration and magnetic extraction of the IOFB in emergency. After a 360° conjunctival peritomy, the sclera was explored and any corneoscleral wounds were closed with multiple interrupted sutures. A sclerotomy 4 mm from the limbus (Pars plana approach) was then performed. A core vitrectomy was done and after indentifying the foreign body it was removed with an endo magnet and forceps if it was a metallic foreign body. Following extraction each foreign body was kept. If a self-sealing wound was found to be unstable during manipulation of IOFB removal, the wound was then closed.

In the presence of vitreous hemorrhage media was cleared by vitrectomy and then PSIOFB removal was attempted.

In case of non metallic foreign body a forceps was used to remove it to prevent vitreous traction and retinal complications. Any impacted site on the retina was treated with endolaser.

2.RD surgery

Green laser photocoagulation around a retinal tear was performed in eyes with relatively clear media and attached retina when indicated. Retinal tears with retinal detachment were localized and a complete Vitrectomy was performed with peripheral vitreous trimming and removal of vitreous adherent to the PSIOFB and around any retinal impact sites to relieve any traction and treated with cryotherapy or external explants as a tamponade with scleral buckling procedures were then carried out and C3F8 gas/silicon oil was used if indicated.

Binocular indirect ophthalmoscopy with scleral depression was performed before closure to assure the lack of iatrogenic retinal breaks, dialyses.

Subconjunctival and postoperative systemic antibiotics were employed in all cases.

Retinal detachment surgery included cryopexy and scleral buckling, pars plana vitrectomy-lensectomy-cryopexy-encircling buckle or pars plana vitrectomy-cryopexy-scleral buckling-gas/oil

An ocular endotamponade was generally not performed if the edges of the retinal lesions were still attached after removal of the FB and after the posterior vitreous surface had completely been removed from the retinal defect. Cryocoagulation or endolaser coagulation was carried out in all eyes with retinal lesions anterior to the equator with no significant differences.

Small paracentral retinal lesions were not coagulated if the retinal edges were still attached after removal of the FB and posterior vitreous cortex.

3. Lensectomy

Pars plana lensectomy- extra capsular cataract extraction or phacoemulcification were performed in eyes with clinically significant lens opacity (Traumatic cataract) or with irrecoverable lens damage owing to PSIOFB perforation. Posterior chamber intraocular lens implantation was performed in certain of these cases primarily and as secondary procedure in some. One-piece PMMA IOL was implanted (IOL with 6 mm optic diameter and 12 mm haptic diameter).

In pars plana lensectomy, the anterior lens capsule is left in place, allowing insertion of a posterior chamber lens implant in the ciliary sulcus.

Complications such as vitreous hemorrhage and retinal tear were managed accordingly.

In cases of endophthalmitis, a vitrectomy was done followed by the administration of intravitreal injection of Vancomycin in conjunction with ceftazidime/Amikacin.

Postoperative complications and their Interventions

Cataract extraction with IOL implantation

- Late onset RD and Surgical correction
- PVR and management

The follow up data

- Final best corrected VA
- Anterior and posterior complications and duration of follow up

RESULTS

RESULTS

- Variables independent of intervention at the time of initial presentation
- Variables dependent on intervention

Age and gender

Age	No of patients
1yr-18yr	1
20-25	6
26-30	4
31-35	6
36-40	3

Table 4

Gender	No of patients
Male	20
Female	0

Table 5

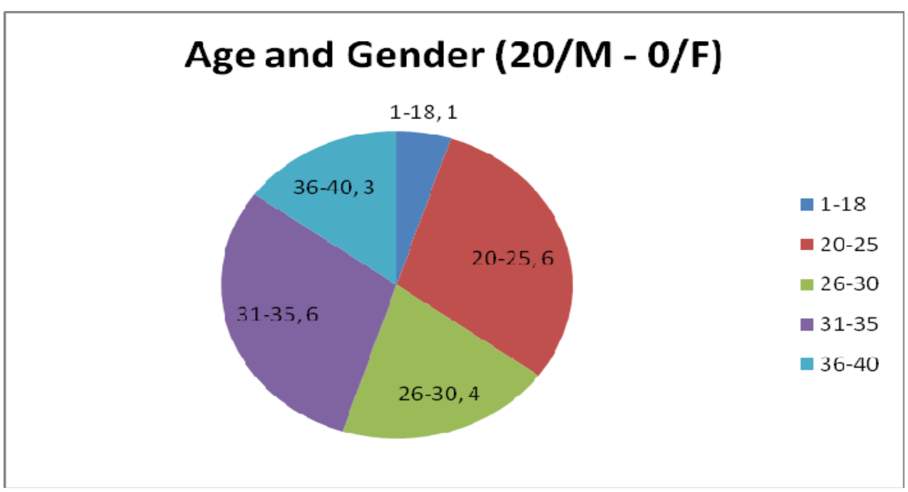


Figure 1

Mode of injury

Mode of injury	No of patients
Metal on metal	12
Stone work	7
Unrelated to work	1

Table 6

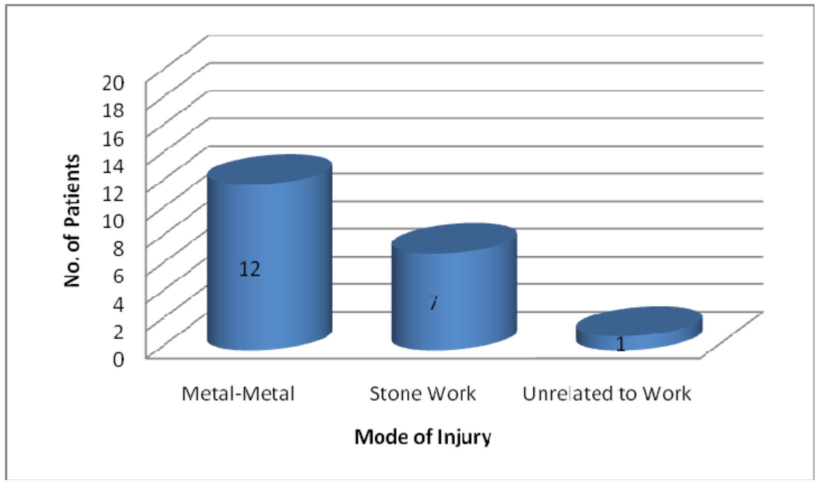


Figure 2

No of PSIOFB

No of PSIOFB	No of patients
Single	19
Multiple	1

Table 7

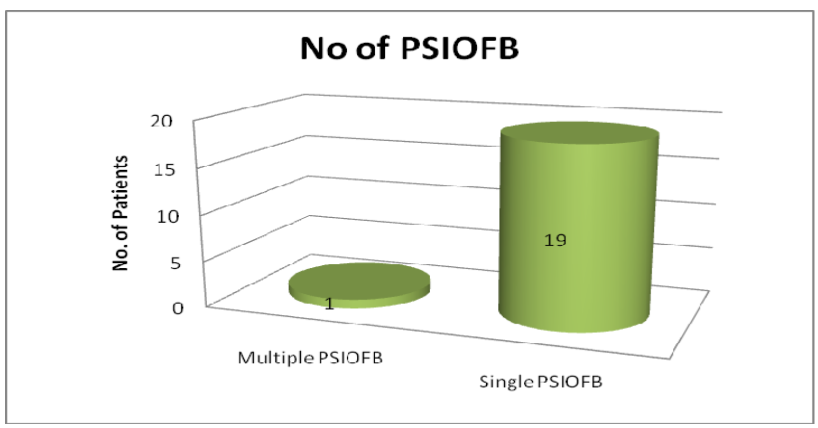


Figure 3

Site of perforation

Site of perforation	No of patients
Cornel	17
Corneo scleral	3

Table 8

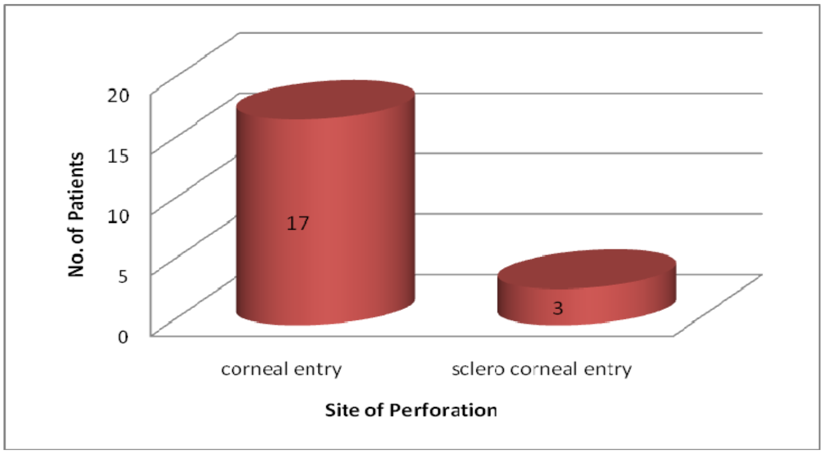


Figure 4

Composition of PSIOFB

Composition of foreign body	No of patients
Iron	12
Stone	8
Organic	0

Table 9

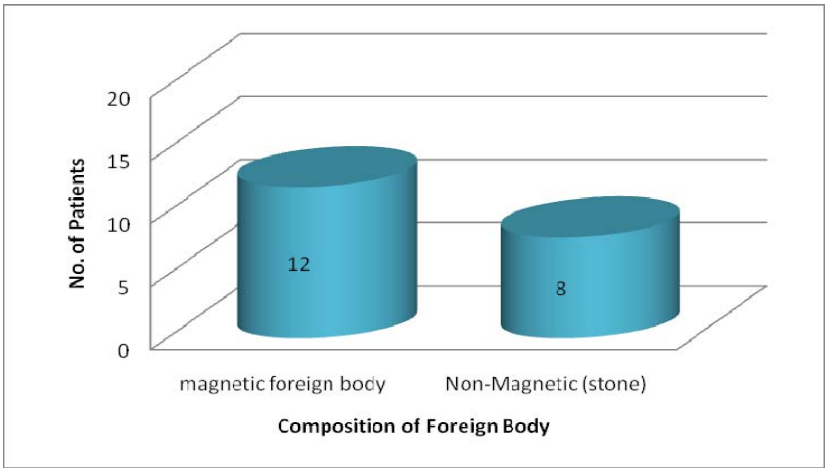


Figure 5

Presenting visual acuity

Initial visual acuity	No of patients
<6/18	2
>6/24	18

Table 10

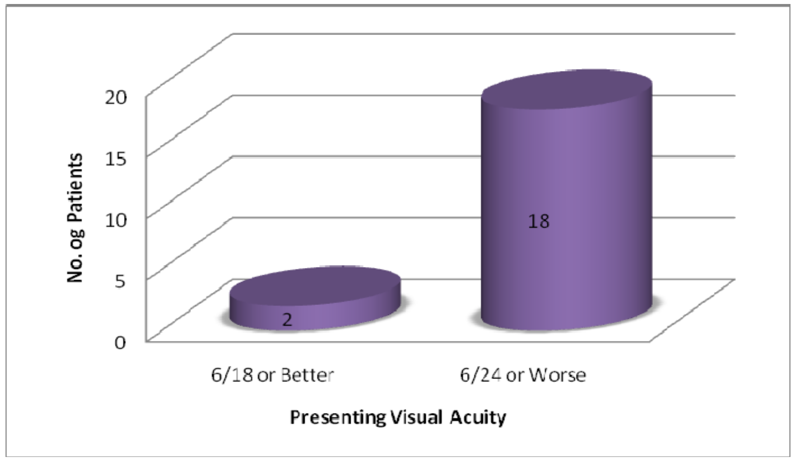


Figure 6

Location of foreign body

Location of foreign body	No of patients
Vitreous	15
Retina	5

Table 11

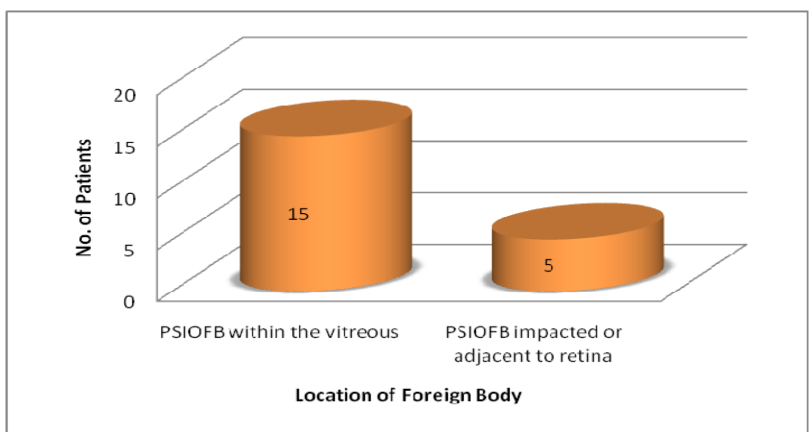
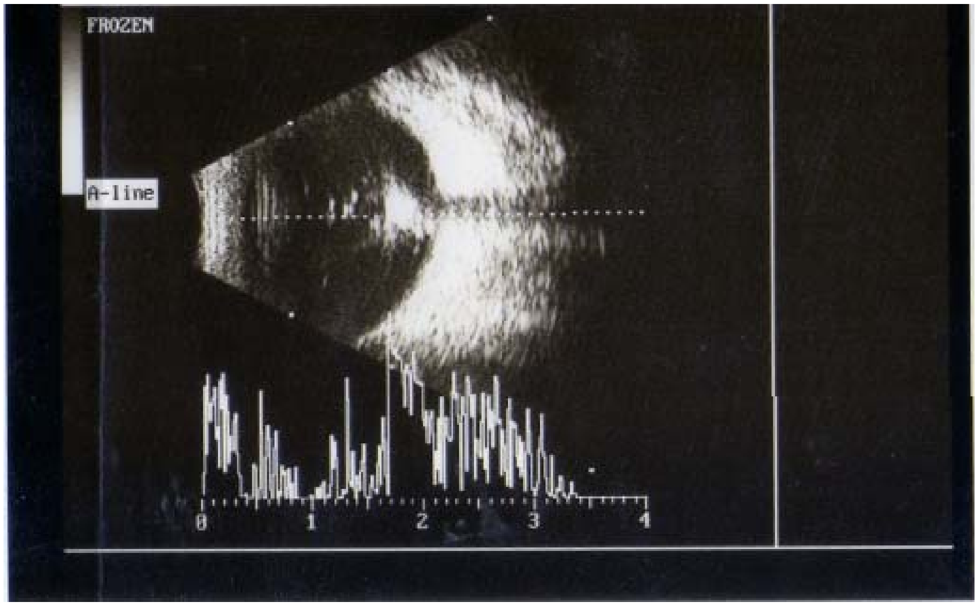
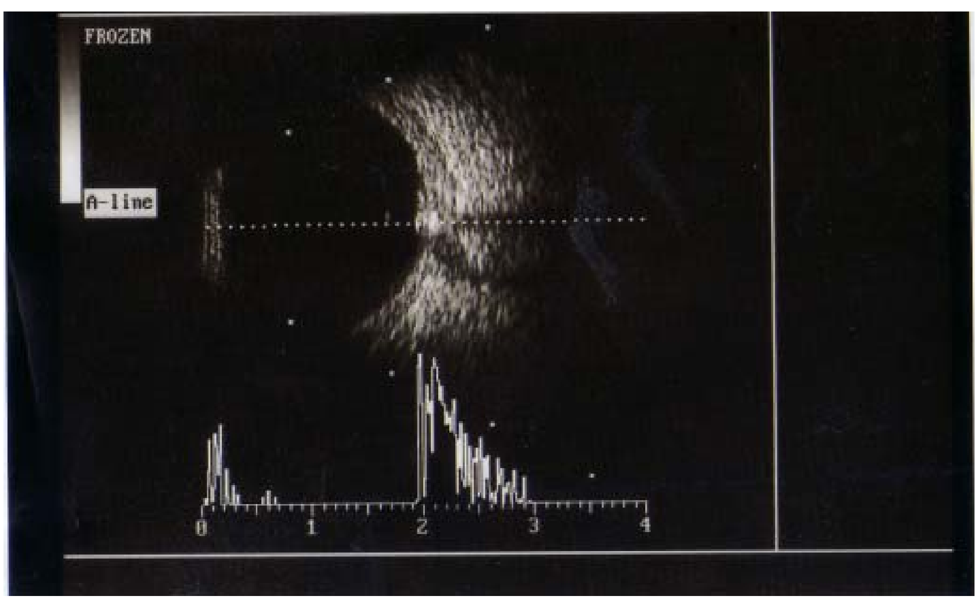


Figure 7

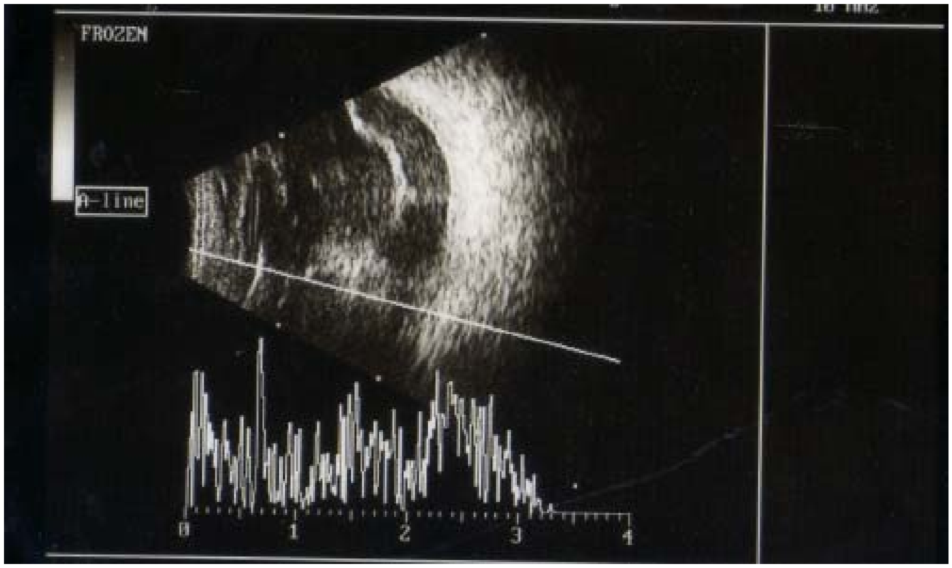
B-scan picture showing an intraocular foreign body with a reverberating echo in the posterior vitreous **Picture 1**



B-scan picture showing an intraocular foreign body impacted on the retina adjacent to the disc **Picture 2**

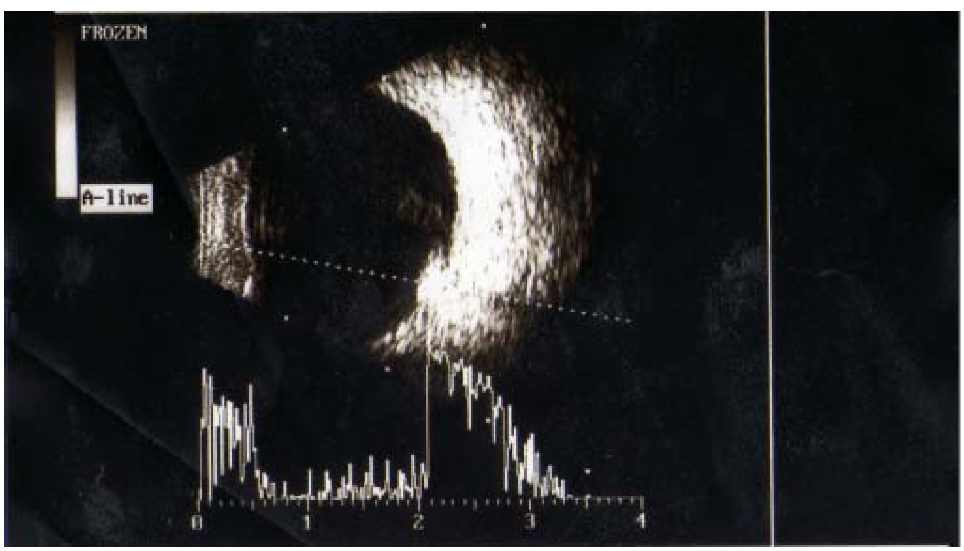


B-scan picture showing an intraocular foreign body with superior temporal retinal detachment **Picture 3**



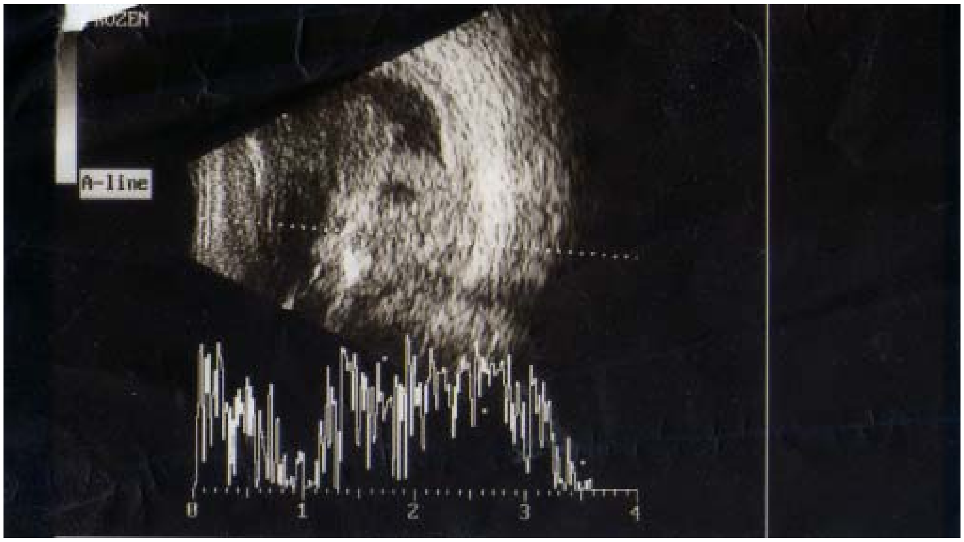
B-scan picture showing an intraocular foreign body impacted on the retina inferiorly

Picture 4



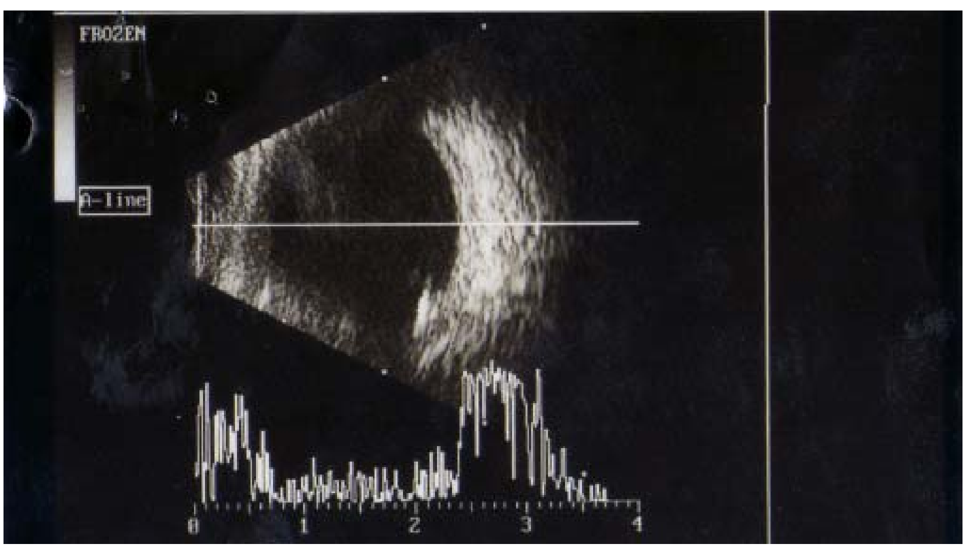
B-scan picture showing an intraocular foreign body with vitreous hemorrhage

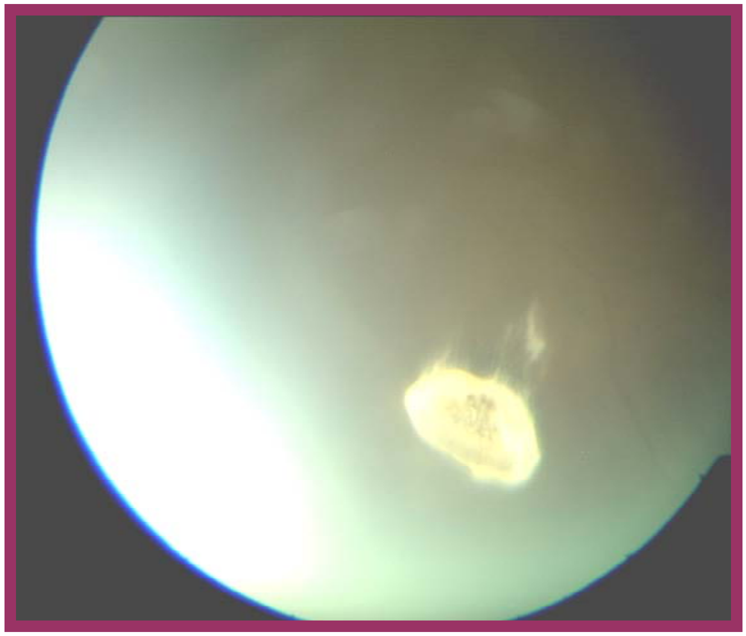
Picture 5



B-scan picture showing an intraocular foreign body impacted on the retina with clear vitreous

Picture 6





Picture 7 **INTRA VITREAL IOFB**

Picture 8 **INTRA VITREAL IOFB WITH VIT HGE**

Initial size of wound

Initial size of the wound	No of patients
<4mm	10
>4mm	8
Scar	2

Table 12

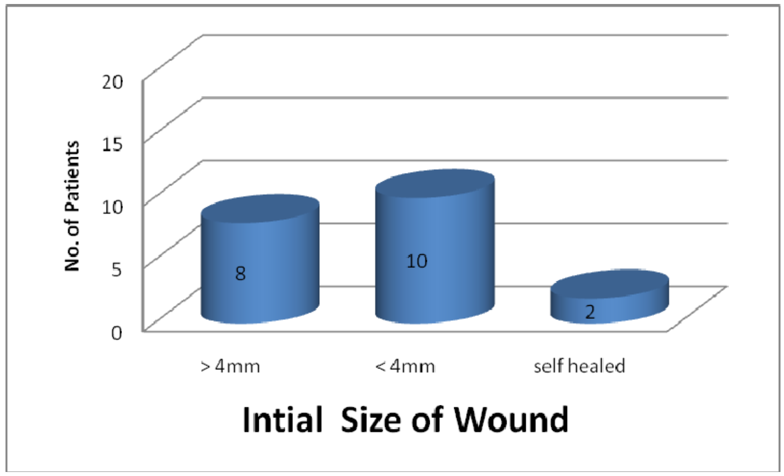


Figure 8

Tiem of arrival/surgery

Time of Arrival	No of patients
<24 hours	2
>24 hours	18

Table 13

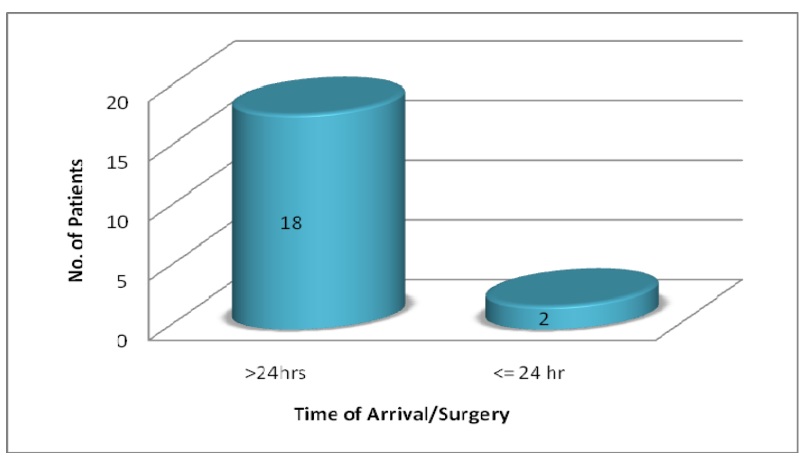


Figure 9

Traumatic cataract

Traumatic cataract	No of patients
With	12
Without	8

Table 14

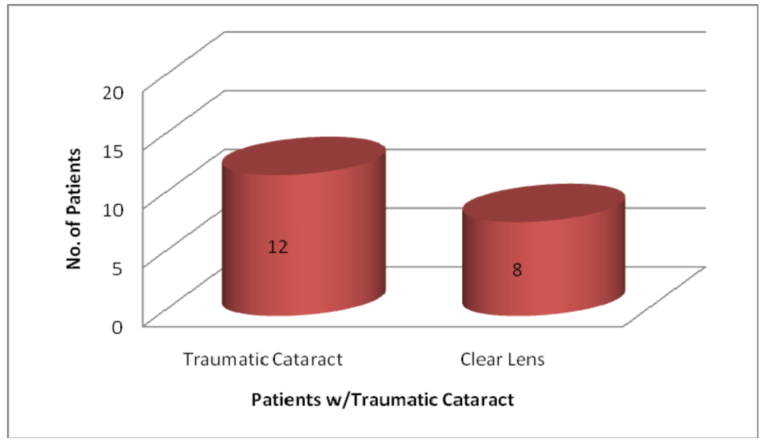


Figure 10

Vitreous hemorrhage

Vitreous Hemorrhage	No of patients
With	6
Without	14

Table 15

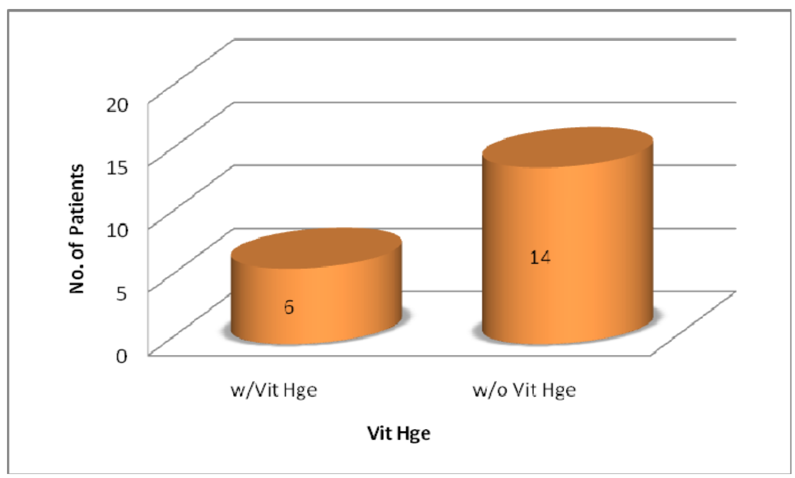


Figure 11

Retinal detachment

RD	No of patients
With	7
Preoperative RD	5
Postoperative RD	2
Without	13

Table 16

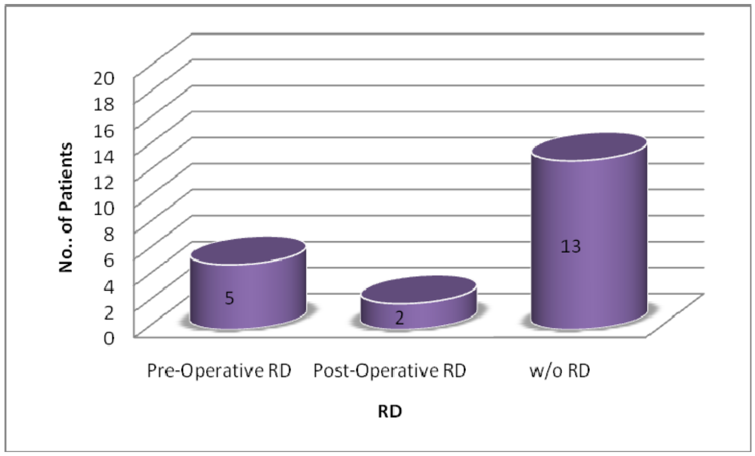


Figure 12

Endophthalmitis

Endophthalmitis	No of patients
With	2
Without	18

Table 17

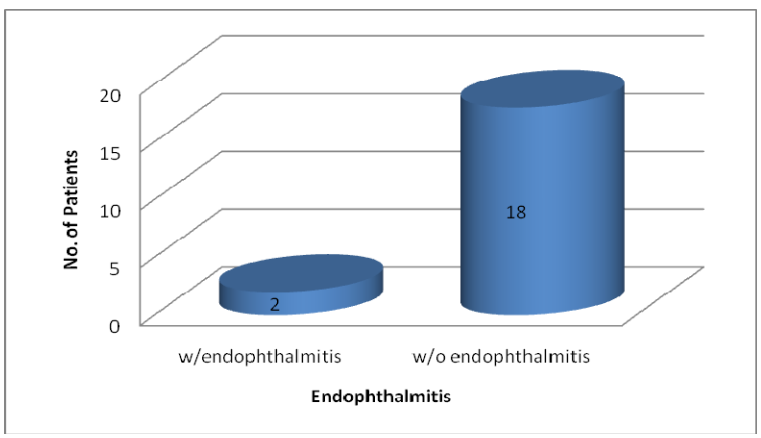


Figure 13

Uveal tissue prolapse

Uveal tissue prolapse	No of patients
With	1
Without	19

Table 18

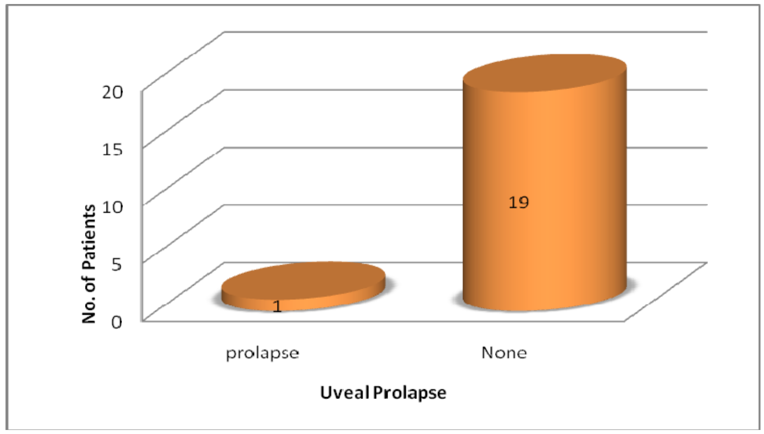


Figure 14

Time of wound repair

Primary wound repair with IOFB removal	No of patients
>24hours of injury	18
<24hours of injury	2

Table 19

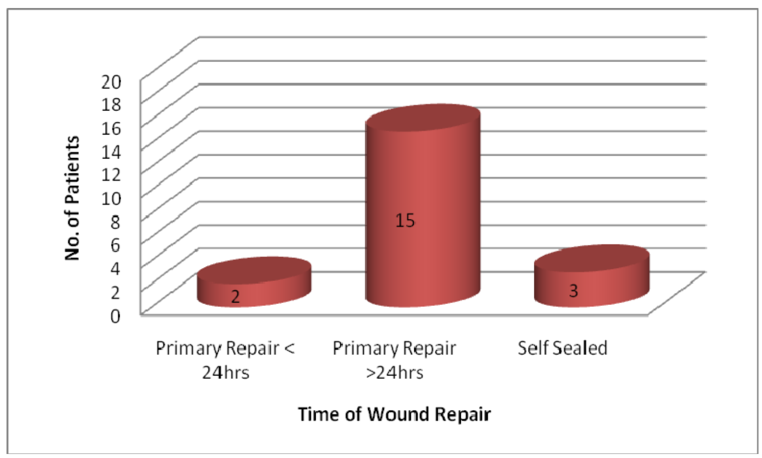


Figure 15

Management of cataract

Traumatic cataract management	No of patients
Aphakia	2
Primary IOL Implant	8
Secondary IOL implant	2

Table 20

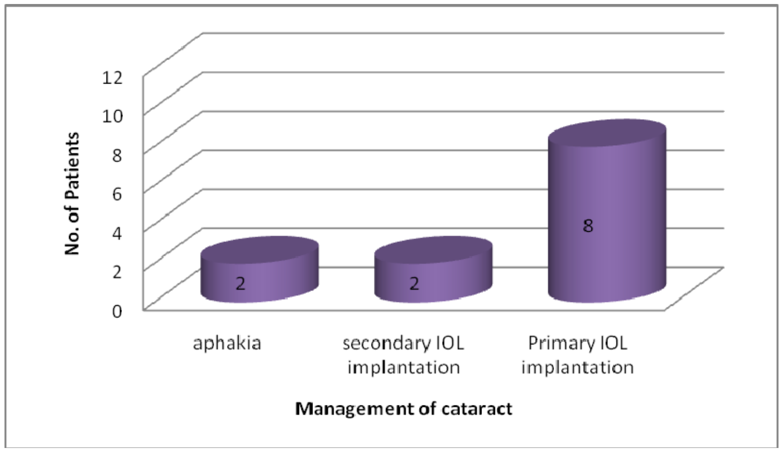


Figure 16

RD management

Management of RD	No of patients
Endolaser	10
External tamp/w Encirc.band	3
Fluid gas exchange	10

Table 21

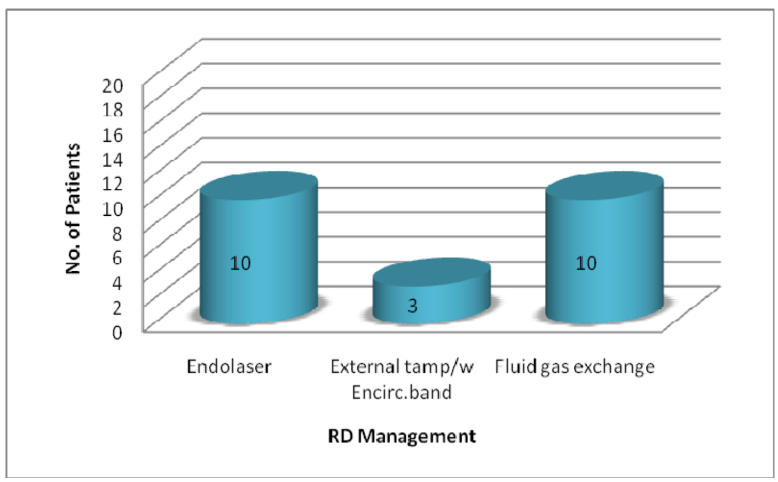


Figure 17

Final BCVA in patients who underwent parsplana vitrectomy

Final BCVA	>6/18	6/24-6/60	<5/60
No of patients	7	5	8

Table 22

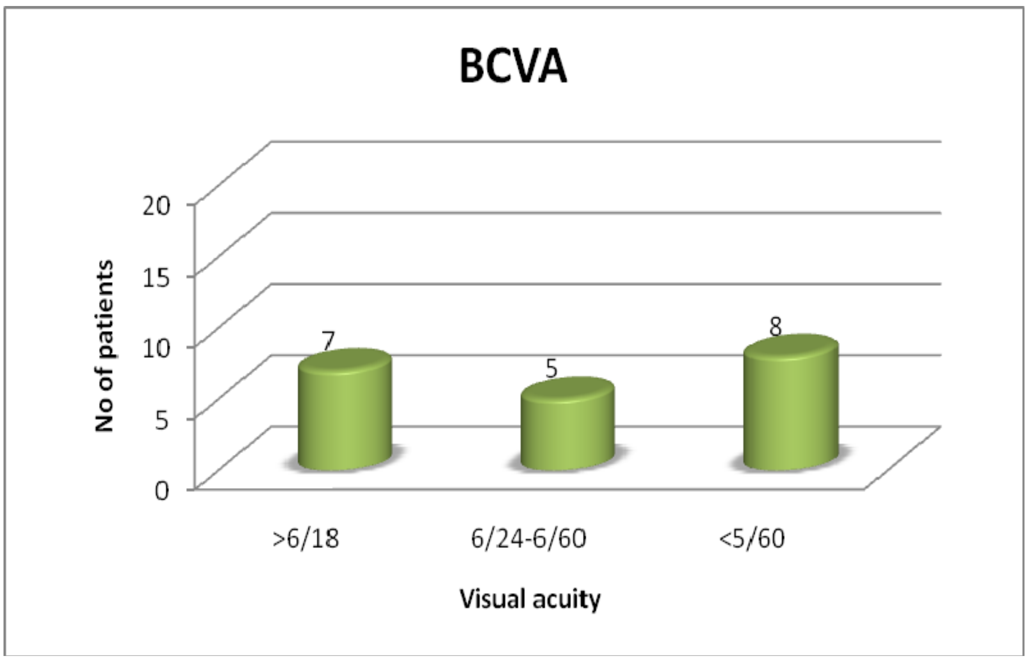


Figure 18

Table 23 **Correlation between presenting features and final visual outcome**

Variables independent of intervention	No of patients	Final Visual Acuity <6/18	Final Visual Acuity >6/24	*P* value
Mode of injury				**P=0.02**
Metal on metal	12	7 (35)%	5 (25)%	
Stone work	7		7 (35)%	
Unrelated to work	1		1 (5)%	
No of PSIOFB				**P=0.45**
Single	19	7 (35)%	12 (60)%	
Multiple	1		1 (5)%	
Site of perforation				**P=0.9**
Cornel	17	6 (30)%	11(55)%	
Corneo scleral	3	1 (5)%	2 (10)%	
Composition of foreign body				**P=0.007**
Iron	12	7 (35)%	5 (25)%	
Stone	8		8 (40)%	
Organic	0			
Location of foreign body				**P=0.058**
Vitreous	15	7 (35)%	8 (40)%	
Retina	5		5 (25)%	
Initial visual acuity				**P=0.04**
<6/18	2	2 (10)%		
>6/24	18	5 (25)%	13 (65)%	
Initial size of the wound				**P=0.02**
<4mm	10	6 (30)%	4 (20%)	
>4mm	8		8 (40)%	
Scar	2	1 (5)%	1 (5)%	
Time of Arrival				**P=0.27**
<24 hours	2		2 (10)%	
>24 hours	18	7 (35)%	11 (55)%	
Traumatic cataract				
With	12			
Without	8			
Vitreous Hemorrhage				**P=0.03**
With	6		6 (30)%	
Without	14	7 (35)%	7 (35)%	

Variables independent of intervention	**No of patients**	Final Visual Acuity <6/18	Final Visual Acuity >6/24	*P* value
RD				**P=0.42**
With	7			
Preoperative RD	5	1 (5)%	4 (20%)	
Post operative RD	2		2 (10)%	
Without	13	6 (30)%	7 (35)%	
Endophthalmitis	2		2	
Variables dependent on intervention				
Primary wound repair with IOFB removal				**P=0.27**
>24hours of injury	18	7 (35)%	11 (55)%	
<24hours of injury	2		2 (10)%	

DISCUSSION

DISCUSSION

PREDICTIVE FACTORS OF FINAL VISION of 6/18 or better

Variables independent of intervention at the time of initial presentation

1. Age & Gender and Functional outcome

Mean age is 29.05 years in our study at JEH. Literature quotes a mean age of 31 years and 95-100% male. (4)

Gender preponderance in our study at JEH is 100% male. Literature quotes a male preponderance of 93%. (4, 8) The data is almost similar regarding gender preponderance.

In our study at JEH, there was one patient below 18 years (17 years); Patient 14.This patient developed a giant retinal tear on the 10th post operative day. The visual acuity remains 1/60 even after 6 months follow up. It is also to be taken into consideration that the PPV with foreign body removal was done 7 days after the injury. This is due to the delayed arrival of the patient.

The late arrival of the patient to the hospital was significantly associated with poor visual outcome irrespective of the age. (9, 5)

Literature quotes patients 18 years or older had better visual outcomes. Poor out come in very young patients were related to the stronger normal vitreous adhesions. (4, 8, 6)

Generally in young patients with IOFB, removal of the posterior hyaloid which is intact may not be possible in the presence of a retinal detachment. This uncompleted vitrectomy will lead to postoperative proliferative vitreoretinopathy. [4, 5, 6, 8, 9]

In our study ,age of the patient was not associated with any significance in the final visual outcome as similar to studies done by Chiquet, J C Zech, P Gain, et al, Imtiaz A. Chaudhry et al , Zsuzsanna Szijarto, et al, Justis P Ehlers et al, Tansu Erakgun, MD, and Sait Egrilmez, MD [4, 5, 6, 8, 9]

We could not compare significance of visual outcome based on gender preponderance as all our patients were male.

Our study also showed that the age of the patient had no bearing on the development of clinical endophthalmitis, which is similar to a study done by Imtiaz A. Chaudhry et al [8]

Our study also showed that age was not significantly associated with the presence of postoperative retinal detachment which is similar to a study done by Tansu Erakgun, MD, and Sait Egrilmez, MD [9]

2. No of IOFB

In our study at JEH 1 patient had multiple IOFB's (1/20) - 5% (Patient 16) and 19 patients had single IOFB (19/20) 95%. The only patient with multiple foreign bodies in the vitreous had a presenting visual acuity of PL+ and PR in all 4 quadrants and a final acuity of 5/60. Though, in similar to the study done by Zsuzsanna Szijarto, et al [5] which related to a bad visual prognosis in multiple IOFB we did not have enough number of patients to arrive at a conclusive statement.

The same study also showed that multiple IOFB is a poor prognostic factor associated with wound length and vitreous hemorrhage

P value for this factor was **P=0.45**.So number of foreign body was **not significantly associated with poor visual prognosis.**

3. Mode of injury

In our study at JEH 12 patients (12/20)-60% comprised of injury related to metal on metal and 7 patients (7/20)-35% were related to stone work. One patient (patient 18) (1/20)-5% had an accidental injury with a stone, when he was uninvolved with any work.

Two patients (2/20 (10%) (Patient 9&14) who had experienced the ocular trauma when hammering on a chisel experienced a posttraumatic infectious endophthalmitis. A study done by Simon R. Lam, et al [(11)] showed that patients with metal-on-metal injuries had a better prognosis than those with other mechanisms of injury. Both our patients who developed endophthalmitis preoperatively were doing metal on metal work at the time of injury.

We think it is due to late arrival of these 2 patients that resulted in endophthalmitis rather than the type of work.

A study done by Tansu Erakgun, MD and Zsuzsanna Szijarto, et al reported that the late arrival of the patient to the hospital was significantly associated with poor visual outcome irrespective of the age. [9, 5]

This analysis is also similar to the study done by Jost B. Jonas, MD et.al [10]. He showed (3/72 [4.2%]) patients who had experienced the ocular trauma when hammering on a chisel experienced a posttraumatic infectious endophthalmitis. In contrast, (2/11 [18.2%]) patients who had worked with soil-contaminated tools developed a posttraumatic infectious endophthalmitis.

P- Value for this factor was **P=0.02**.Mode of injury was **significantly associated with poor visual prognosis.**

One key feature of these injuries is the lack of eye protection, with fewer than 10% of patients using eye protection.

4. Location of foreign body and Functional outcome

In our Study at JEH Fifteen of the twenty (15/20)-75% patients had PSIOFB within the vitreous five patients (5/20)-25% had PSIOFB impacted or adjacent to retina.

Of the 25% PSIOFB on retina 2(patients 11 and 12) had a BCVA of 6/36 & 6/60.

3 patients (9, 14, and 15) had a BCVA of 1/60, 1/60, and 2/60 respectively.

Of the 75% PSIOFB in the vitreous 7 patients had a BCVA of 6/18 or better, 4 patients had 6/60 or better and 4 patients had bad visual prognosis.

Of the 7 patients who had good BCVA did not produce any vitreous reactions.

On the overall 7 patients had a BCVA of 6/18 or better, 6 patients had 6/60 or better, 7 patients had bad visual prognosis.

None of our patients who had PSIOFB impacted on the retina had a good BCVA.This corresponds to a study done by Jager and Von Graefe.[2] But other studies like done by Chiquet, J C Zech, Gain, et al [4]and Tansu Erakgun, MD et.al [9] showed that there was no clear difference in visual outcome and development of postoperative retinal detachment between IOFBs located within the vitreous and those adjacent to the retina.

P value for this factor was **P=0.058**.Though it is not statistically significant location of PSIOFB affected final BCVA.

5. Composition

Composition of foreign body and endophthalmitis and poor prognosis

In our study at JEH Magnetic IOFB was 12/20-60%, Nonmagnetic (stone) 8/20-40%.

The incidence of post operative retinal detachment was seen in two patients (Patient 13 &14) 2/20-10%.

Patient 13 had a stone PSIOFB who arrived 20 minutes after injury and patient 14 was a 17 year old with an Iron PSIOFB.

The composition of IOFB was not significantly associated with the presence of postoperative retinal detachment. This is similar to a study done by Tansu Erakgun, MD et al. [9]

There were 2 patients with endophthalmitis in our study patient14& 9. Both had an iron PSIOFB.

A study done by Jost B. Jonas, MD et al [10] showed (2/4 [50%]) wooden FBs and 5 of the 123 (5/123 [4.1%]) metallic IOFBs were associated with an infectious endophthalmitis. This difference was statistically significant (P = 0.01).

Regarding the development of endophthalmitis based on the composition of IOFB there was no organic IOFB in our study to understand the significance.

A study done by Imtiaz A. Chaudhry et al [8] showed that that composition of IOFB had no significant effect on the development of clinical endophthalmitis. In particular, eyes with wood IOFB did not appear to be associated with increased risk of endophthalmitis compared to eyes with metallic IOFBs.

P value for this factor was **P =0.007.**Composition of PSIOFB was **significantly associated with final BCVA.**

6.Site of perforation and functional out come

Though studies done by C Chiquet et al [4] showed that corneal IOFB to be (58%), followed by the sclera (32%)and Zsuzsanna Szijarto, et al [5] 68% corneal and 32% sclera corneal our study at JEH had a higher percentage.17/20 patients-85% had a corneal entry wound and 3/20 patients-15% had sclero corneal entry wound.

2 out of 3 patients who had sclero corneal entry wound had a visual acuity of 6/24& 3/60 (patient 3 & 4) postoperatively. They both had vitreous hemorrhage. But their presenting visual acuity was 6/36 and PL+PR present in all 4 quadrants respectively.

The other patient with sclero corneal entry wound (patient 10) had a BCVA of 6/6 parts. The patients presenting visual acuity was 6/18 parts.

6/17(35.2%) patients with corneal entry wound had a BCVA better than 6/18, 5/17 patients had a BCVA between 6/24 & 6/60 and 6/17 had BCVA >5/60.

Here of the 6/17 patients who had a good BCVA better than 6/18, 4 had traumatic cataract and 2 had posterior sub capsular cataract. 5/6 patients had a presenting visual acuity 6/60 or worse due to the presence of traumatic cataract or posterior sub capsular cataract. They had a good BCVA following removal of cataract with or without IOL implantation. None of the remaining 11/17 patients who had visual acuity of 6/24 or worse with a corneal entry wound had a good presenting acuity.

On the whole 13/20-65% patients who had BCVA of 6/24 or worse did not have a good

We conclude that the site of perforation was not involved in the final BCVA which in deed was affected by the presence of other factors like vitreous hemorrhage, RD and presenting acuity.

P value for this factor was **P =0.9.** Site of perforation was **not significantly associated with final BCVA.**

7. Initial visual acuity - anatomic out come

In our study at JEH 18/20-90% patients had a bad presenting visual acuity of 6/24 or worse.

Of these 5 patients (5/20)-25%, who had bad presenting visual acuity, had a BCVA of 6/18 or better. None of these patients had other complications such as hyphaema, vitreous hemorrhage, or uveal tissue prolapse.

2/20-10% patients, who had better presenting visual acuity, had a BCVA of 6/18 or better.

13/20-65% patients, who had BCVA of 6/24 or worse, did not have a good presenting acuity.

In concordance with studies done by C Chiquet et al (4) and Imtiaz A. Chaudhry et al (8) our shows that presenting visual acuity is significantly associated with final BCVA.

P value for this factor was **P =0.04.Presenting visual acuity in our study affected significantly the final visual outcome**.

8. Initial size of the wound

8 patients (8/20)-40% had 4mm or bigger corneal/corneoscleral wound.

10 patients (10/20)-50% had <4mm wound.

2 patients (2/20)-10% had self healed corneal wound.

Of the 8 patients who had 4mm or bigger corneal/corneoscleral wound, 7 patients presented with vitreous hemorrhage, RD or both.

But the remaining one patient had the foreign body impacted on to the retina.

Of the 10 patients, who had <4mm wound, 5 patients (5/10) 3 had RD,1 had vitreous hemorrhage,1 presented with vitreous cells.

2/5 of them had a BCVA of 6/18 or better.3/5 of them had poor BCVA.

Remaining 5 patients (5/10) had clear vitreous and normal retina preoperatively. 4/5 of these patients had a BCVA 6/18 or better post operatively.

The remaining 1 patient had a BCVA of 6/60. This was related to the poor presenting visual acuity (patient 5) and delay in the arrival to the hospital.

Our study shows that smaller wound size as such is no guaranty for a good visual prognosis postoperatively. This is due to the presence of associated risk factors like RD, vitreous hemorrhage and vitreous cells.

But at the same time lager wound size > 4mm is definitely associated with poor postoperative visual prognosis since it is invariably associated with more risk factors. This is also reflected in a study done by C Chiquet et al. [4]

P value for this factor was **P =0.02.Initial size of the wound in our study affected significantly the final visual outcome**.

9. Time of surgery/arrival

Only 2 patients (2/20)-10% arrived within 1 hour of injury. 18/20-90% patients arrived after at least 24 hours of injury.

7/18 patients who arrived after 24 hours had BCVA better than 6/18 but the remaining 11 patients had a poor BCVA.

6/11 patients had vitreous hemorrhage, 3/11 patients had only retinal tear or along with vitreous hemorrhage, 2/11 patients did not have documented ocular pathology.

But the 2 patients who arrived early too had a poor BCVA since they either had Retinal tear or vitreous hemorrhage.

Approximately 61% of the 18 patients who arrived after 24 hours had a poor BCVA.

39% of the 18 patients who arrived after 24 hours had BCVA better than 6/18.

100% of patients who arrived within 1 hour of injury had poor visual acuity.

Though 100% of patients who arrived within 1 hour of injury had poor BCVA and 62% of the late arrival patients had poor BCVA there is no definitive statistical link to show that late arrival alone is a precursor for a poor visual prognosis. The 2 patients who arrived early to the hospital had a corneal wound size of >4mm and a poor presenting visual acuity which itself are poor prognostic factors from our study.

4 patients had vitreous traction or PVR post operatively, 1 had ERM at the macula, 1 had superotemporal RD and 1 had a giant retinal tear.

At the same time the patients who came late to the hospital also had wound <4mm. We did not have the data to show early arrival to the hospital resulted in good visual prognosis. We found that late arrival to the hospital resulted in further post operative complications but was not statistically significant. A study done by C Chiquet et al. [4], Imtiaz A. Chaudhry et al [8,] Justis P. Ehlers, et al [6] and Tansu Erakgun, MD et al [9] also showed similar results.

Justis P. Ehlers, et al [6] suggests that emergent IOFB removal (within hours) may not be as necessary as previously thought as long as the open-globe injury is closed promptly and systemic antibiotics are initiated quickly.

P value for this factor was **P =0.27.Time of arrival to the hospital and early surgery did not affect significantly the final visual outcome** in our study.

10. Traumatic cataract

12/20 patients had traumatic cataract.2 patients were rendered aphakic since these 2 patients were not willing for a secondary IOL implantation. 2 had secondary IOL implantation, 8 patients had primary IOL implantation. Of the 8 patients who had primary IOL implantation 5 patients had BCVA of 6/18 or better. None of them had RD following implantation. Tansu Erakgun, MD et al [9] says that pars plana lensectomy and primary implantation of an intraocular lens was not significantly associated with the presence of postoperative retinal detachment. P value 0.1

We feel that cataract as such is not a preclude of poor BCVA. To substantiate this, 5/12 patients with PSIOFB with traumatic cataract did not have any other associated posterior segment pathology and all these patients had a BCVA 6/18 or better. So removal of cataract in the absence of other associated pathology can improve visual acuity. C Chiquet et al. [4] and Tansu Erakgun, MD et al [9] showed that secondary cataract had no significant effect on the final visual results the similar results

11. Vitreous Hemorrhage

6/20 patients had presenting vitreous hemorrhage.

As a functional factor, all 6 patients-100% had poor post operative BCVA.

As a anatomical factor that determined the final visual acuity,3 patients had vitreous traction along vascular arcades, 1 had ERM,1 had a superior RD and PVR and 1 patient did not have any complications.

In concordance with a study done by Tansu Erakgun, MD et al [9] our study also showed that intravitreal hemorrhage was reported to be associated with intraocular proliferation and traction detachment of retina. Tansu Erakgun, MD et al [9] study also showed that the presence of preoperative intraocular hemorrhage was predictive of postoperative retinal detachment i.e., poor prognosis. P value of 0.01

In conclusion, the presence of preoperative intraocular hemorrhage was predictive of postoperative retinal detachment and poor visual acuity.

P value for this factor was **P =0.03.Vitreous hemorrhage in our study affected significantly the final visual outcome**.

12. RD

The incidence of retinal lesion is 26-68% in PSIOFB. [5, 20]

The incidence of retinal tear/RD in our study was 5/20- 25% before PPV (Literature reports to be 15% to 37%) [2] and 2/20 patients-10% after PPV. Of the 5 patients who had RD before PPV only one patient had a good BCVA.

80% of the patient with preoperative retinal tear had poor visual prognosis. 2 patients who developed RD postoperatively also had poor visual prognosis.

Endo laser was given for 10 patients. Among them 5 patients had preoperative retinal tear.

3 of these patients underwent external band buckling and along with 360 degree encircling band. None of them had good visual prognosis. The remaining 2 had only fluid gas exchange. Both had poor visual prognosis.

Among the rest of the 5 patients, 3 of them had clear vitreous but with PSIOFB seen either in the posterior vitreous or impacted on to the retina. 1 had vitreous hemorrhage and the other had vitreous cells.

2 patients who developed postoperative RD had vitreous hemorrhage and PSIOFB impacted on the retina. They had a prophylactic external tamponade with 360 degree encircling band. But that did not prevent them from developing a GRT and a superior RD.

Our result coincides with the studies done by C Chiquet et al [4] that showed, if a patient presented a retinal detachment, there was 75% probability that the final VA would also be worse than 20/400 and the presence of initial or secondary retinal detachment (p = 0.0001)

Imtiaz A. Chaudhry [8] and showed that preoperative retinal detachment may be present in 21% of the eyes with IOFB and has been reported to be an important risk factor for poor visual outcome.

Tansu Erakgun, MD [9] and showed that preoperative retinal detachment was a significant predictor of the development of a postoperative retinal detachment and poor visual prognosis.

A study by JUSTIS P. EHLERS [6] showed that to be the most common complication, with a rate of 20%.

P value for this factor was **P =0.4.Preoperative RD did not significantly affect final visual acuity in our study**.

13. Pars plana vitrectomy

2/20-10% patients had primary repair of the wound with IOFB removal within 24 hours of injury.

15/20-75% patients had primary repair of the wound with IOFB removal after 24 hours of injury. This was due to the late presentation of these patients.

There is no statistical evidence from our study to show that early PPV prevented postoperative complications because the 2 patients for who primary repair was done within 24 hours of injury one of them presented with preoperative retinal tear and the other had a large wound with uveal tissue prolapsed along with vitreous hemorrhage.

Of the 15 patients who had primary repair of the wound with IOFB removal after 24 hours of injury 7 patients-47% had good visual prognosis and 8/15 patients-54% had poor prognosis. So there was no conclusive evidence from our study.

D J Weissgold and P Kaushal et al [11] concluded that vitrectomy should be performed within 14 days after ocular trauma. With early vitrectomy performed in the first four days, retinal tears and detachment can be treated and fibro cellular proliferation can be prevented.

Imtiaz A. Chaudhry [8] showed that early vitrectomy has helped in attaining useful functional vision in 25-51% of the eyes with posterior segment trauma and in some cases help salvage eyes where it has helped in significant survival of eyes without improvement of final visual outcome.

Zsuzsanna Szijarto,et al [5] also concluded the same

14. Endophthalmitis

Two patients (2/20 (10%) (Patient 9&14) who had experienced the ocular trauma when hammering on a chisel experienced a posttraumatic infectious endophthalmitis. This analysis is similar to the study done by Jost B. Jonas, MD et al [10]

Our study was in concordance with a study by Imtiaz A. Chaudhry et al[8] and Zsuzsanna Szijarto,et al [5]that showed a delay in intervention of more than 24-hours was associated with a risk of clinical endophthalmitis

Our study was also in concordance with a study by Jost B. Jonas, MD et al [10] that showed (3/72 [4.2%]) patients who had experienced the ocular trauma when hammering on a chisel experienced a posttraumatic infectious endophthalmitis. In contrast, (2/11 [18.2%]) patients who had worked with soil-contaminated tools developed a posttraumatic infectious endophthalmitis. The difference was not statistically significant (P = 0.13)

We think it is due to late arrival of these 2 patients that resulted in endophthalmitis.

Of these 2 patients 1 had giant retinal tear and the other had fibrous tissue proliferation along superior vacular archades.

Both had bad presenting visual acuity.

Since in our study we had 90% of the patients arriving late to the hospital we could not definitely attribute the incidence of endophthalmitis in our study to this factor alone.

Most probably both of them had an PSIOFB that was contaminated with soil that lead to the development of endophthalmitis.

15. PVR

Only 1 patient (13) developed PVR with Superior RD 2 months after management of PSIOFB. He presented with vitreous hemorrhage after the injury. This was in concordance with a study by Cardil-lo et al [12] **that** showed vitreous hemorrhage, a persistent intraocular inflammation or a posteriorly located wound were independent predictive factors for the development of post-traumatic proliferative vitreoretinopathy

4 patients (4, 9, 15, and 17) who had fibrous tissue either on the macula or along the vascular archades also had vitreous hemorrhage at the time of presentation to the hospital.

Except one patient (9) who had a BCVA of 6/18 the rest of the 4 patients had poor BCVA.

We also found that intraocular fibroblastic proliferation leads to a poor prognosis. Similarly other studies done by Clearly & Ryan 1979a, 1979b [3], Winthrop et al. 1980 [13], Johnston 1971; Percival 1972b [14], Faulborn et al. 1977 [15], Brinton et al. 1982 [16] also concluded the same.

We conclude that the presence of vitreous hemorrhage is a poor prognostic indicator.

16. Primary entrance wound repair combined with IOFB

A study done on 42 patients done **by Tansu Erakgun, MD, and Sait Egrilmez, MD** published in **J Trauma. 2008; 64:1034-1037** showed that primary entrance wound repair combined with IOFB extraction was significantly associated with postoperative retinal detachment in the presence of media opacity like corneal edema, vitreous hemorrhage which reduces visualization during vitrectomy. This was a significant predictor of the development of a postoperative retinal detachment. P-value 0 .049

There is no statistical evidence from our study to show that early PPV prevented postoperative complications because the 2 patients for who primary repair was done within 24 hours of injury one of them presented with preoperative retinal tear and the other had a large wound with uveal tissue prolapsed along with vitreous hemorrhage.

Of the 15 patients who had primary repair of the wound with IOFB removal after 24 hours of injury 7 patients-47% had good visual prognosis and 8/15 patients-54% had poor prognosis's there was no conclusive evidence from our study.

P value for this factor was **P =0.27.Primary wound repair with IOFB removal did not significantly affect final visual acuity in our study**.

17. Retinal leision

In the literature, IOFB has a 68% risk of causing one and 21% risk of causing two or more retinal lesions [2, 3]

5/20 patients had either RD or Retinal tear. Only 1/5-20% went on to have good visual acuity. 4/5-80% patients had poor visual acuity. This was in concordance with the study done by Zsuzsanna Szijarto, et al [5]

CONCLUSION

CONCLUSION

Several prognostic factors were identified in our study which helped in predicting the final visual out come. Most of these factors were independent of intervention and can be identified at the time of presentation.

We found a gender preponderance of 100% male in our study

Mean age is 29.05 years

Significant predictors of final BCVA in our study are

- Mode of injury-P value=0.02
- Composition of PSIOFB-P value=0.007
- Presenting visual acuity-P value=0.04
- Initial wound size-P value=0.02
- Vitreous hemorrhage-P value=0.03

Factors that did not significantly affect final visual outcome are

- Location of PSIOFB-P value=0.058
- No. of PSIOFB-P value=0.45
- Site of perforation-P value=0.9
- Time of arrival-P value=0.27
- Retinal detachment-P value=0.42
- Primary wound repair-P value=0.27

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PROFORMA

Institute of Ophthalmology

Joseph Eye Hospital, Trichy

Serial No : MRD No :

Date :

Name : Age : Sex :

Address :

Occupation :

Diagnosis : Right eye :

Left eye :

Nature of Trauma : Penetrating :

Blunt :

Agent : Stick ☐, Stone ☐, Glass ☐, Iron ☐, Finger ☐, Needle ☐,

Thorn ☐, Others ☐

Treatment History : Not taken ☐ Taken : Native ☐

Medical ☐

Surgical Others ☐

Time Interval between trauma & consultation : 1 to 2 Days ☐ , 3 to 4 Days ☐ , > 4 days ☐

Pre-Existing

Ocular diseases : Nil ☐ , Old scar ☐, Corneal Astigmatism ☐

Myopia ☐ , Hypermetropia ☐ , Amblyopia ☐

Previous Ocular

Surgery : Nil ☐ ,Retinal Detachment ☐ , Keratoplasty ☐,

Others ☐

Examination:

General :

Ocular :

Lids and Adnexa : Normal ☐ , Lid tear ☐, Lid Oedema ☐ ,

Ecchymosis☐, Crepitus ☐ , Others☐.

Conjunctiva : Normal ☐,Congestion ☐ , Chemosis ☐, SCH ☐ ,

Conjunctival ☐ , Tear ☐ , Foreign body ☐, Others ☐

Sclera : Normal ☐ ,Scleral Tear ☐

Cornea : Tear - present — Full thickness / Partial thickness

Not present

- Sealed ☐ , Gaping ☐ , Leaking ☐

-Shape – linear ☐ , Curved ☐ , Rugged ☐

- Site – Optical zone ☐, Peripheral ☐ , Mid peripheral ☐

-Size- < ½ corneal diameter ☐ ,> ½ corneal diameter ☐

- Descemets Folds – Present ☐ ,not present ☐

- Blood staining – Present ☐ , not present ☐

- Foreign body – Present ☐, not present

Anterior Chamber : Normal ☐ ,Irregular ☐ ,collapsed ☐ ,Hypopyon ☐ ,

Hyphema ☐ , lens material ☐ , F.B ☐ ,Flare ( )

,Cells ( ) , Vitreous ☐ , Others ☐

Iris : Normal ☐, sphincter tear ☐ ,Hole ☐, Dialysis ☐,

Blood clot ☐ ,F.B. ☐ ,Fibrous membrane ☐,

Exudative membrane ☐

Pupil : Size ☐ ,Shape☐, Regular ☐ ,Irregular ☐ ,Reacting ☐ ,

Non reacting ☐

Lens : Type of cataract

Capsular tear – Present : Anterior ☐ , Posterior ☐

- Not present

Prolapsed Lens material ,Subluxated ,Dislocated

Vitreous : Clear ☐ , Vitreous hemorrhage ☐, Vitritis -Flare ( ),

Cells ( ) ,Others ☐

Fundus :

Investigation

Ocular

Vision (Right eye) : with PH

(Left eye) : with PH

Tension (Right eye) :

(Left eye) :

N.L. Duct (Right eye) :

(Left eye) :

USG	- A Scan - B Scan
Clinical Photo	: Taken □ , Not taken □
General	: Pulse □ ,Blood pressure □,Blood Sugar □, Urine sugar □, Weight □, Hemoglobin □
Anesthesia	: Local anaesthesia □, General aneaesthesia □
Surgical procedure	:
Condition at discharge Vision Intraocular pressure Slit Lamp	 : with pinhole : : Cornea □, Anterior Chamber □, Pupil Iris □, PC IOL □
Fundus	: Disc □, Vessels □ , Macula □

Follow up

	Vision	Slit lamp	Fundus
2nd week			
4th week			
6th week			
3 months			