Dissertation on

AN ANALYTICAL STUDY OF 100 CASES OF PENETRATING INJURIES

Submitted in partial fulfillment of requirements of

M.S. OPHTHALMOLOGY
BRANCH - III

REGIONAL INSTITUTE OF OPHTHALMOLOGY
MADRAS MEDICAL COLLEGE
CHENNAI- 600 003

THE TAMILNADU
DR.M.G.R. MEDICAL UNIVERSITY
CHENNAI

APRIL 2011

CERTIFICATE

This is to certify that this dissertation entitled **"AN ANALYTICAL STUDY OF 100 CASES OF PENETRATING INJURIES"** is a bonafide record of the research work done by **Dr.C.PREMANAND.,** Post graduate in Regional Institute of Ophthalmology, Madras Medical College and Research Institute, Government General Hospital,Chennai-03, in partial fulfillment of the regulations laid down by The Tamil Nadu Dr.M.G.R. Medical University for the award of M.S. Ophthalmology Branch III, under my guidance and supervision during the academic years 2008-2011.

Prof.Dr.K. Namitha Bhuvaneswari, M.S.,D.O.,
Professor of Ophthalmology
Head of Department of Squint and
Neuro Ophthal Services
Regional Institute of Ophthalmology
Govt. Ophthalmic Hospital
Egmore, Chennai - 600 008.

Prof.Dr.K.Vasantha, M.S., FRCS.,
Director and Superintendent
Regional Institute of Ophthalmology
Govt. Ophthalmic Hospital
Egmore, Chennai - 600 008.

Prof.Dr.J.MOHANASUNDARAM, M.D, D.N.B, Ph.D.

DEAN
MADRAS MEDICAL COLLEGE&GOVT.GENERAL HOSPITAL,
CHENNAI – 600 003.

ACKNOWLEDGEMENT

I express my sincere thanks and gratitude to **Prof. Dr. J. MOHANASUNDARAM, M.D., D.N.B., Ph.D.,** Dean, Madras Medical College for permitting me to conduct this study.

I have great pleasure in thanking Professor **Dr. K. VASANTHA, M.S., F.R.C.S,** Director and Superintendent RIO – GOH, Madras Medical College, Chennai, for her valuable advice in preparing this dissertation.

I express my profound gratitude to Prof. **Dr. K. NAMITHA BHUVANESWARI, M.S., D.O.,** my unit chief and my guide for her valuable guidance and constant support at every stage throughout the period of this study.

I am very grateful to my unit assistants **Dr. B. PRAMILA, M.S., Dr. P. GEETHA M.S.,** and **Dr. T. G. UMA MAHESHWARI, M.S.,** for rendering their valuable advice and guidance for the study.

I wish to express my sincere thanks to all the professors, assistant professors and all my colleagues who had helped me in bringing out this study.

Finally, I am indebted to all the patients for their sincere co-operation for the completion of this study.

CONTENTS

INTRODUCTION

Nature offers protection to the eye, anatomically by its situation in the elastic fatty tissues of the orbital cavity and sturdy bony projections of the orbital rim and the nose, physiologically by the vigilance exercised by the blink reflex and the head – turning reflex on the approach of objects. Despite these protection injuries to the eyes are common and may involve any tissue[1]. Moreover, the effects of such injuries are much more severe than in any other parts of the body, because of the delicacy of the ocular tissues. Ocular injuries therefore assume marked social and economic importance involving a huge cost in human unhappiness and economic inefficiency.

CLASSIFICATION OF OCULAR INJURIES

Ocular injuries are anatomically classified as intraocular injuries and extraocular injuries. Extraocular injuries are lid lacerations, orbital fractures, orbital hemorrhage, traumatic optic neuropathy etc.

Ocular Trauma classification group[2] has classified intraocular mechanical injuries into closed globe and open globe injuries.

This classification is based on the following variables.

1. Type of Injury

Closed globe injuries:

Ocular injury without full thickness defect of the coats. They are contusion, lamellar laceration (partial thickness injury of the coats), superficial foreign body or mixed.

Open globe Injuries

Full thickness defects in the corneoscleral coat of the eye. They are full thickness laceration (can be penetrating injury if the object traverses the coats only once or perforating injury if both an entry and exit wounds are present), rupture (full thickness break in the ocular coats due to blunt trauma), intraocular foreign body or mixed.

2. Grade of injury (based on the visual acuity of the involved eye at the time of presentation)

Grade 1	:	greater or equal to 20/40
Grade 2	:	20/50 to 20/100
Grade 3	:	19/100 to 5/200
Grade 4	:	4/200 to light perception
Grade 5	:	no light perception

3. **Relative afferent pupillary defect –** Positive / negative

4. Zone of injury – based on the location

In open globe injury,

Zone 1: Isolated to the cornea (including the limbus)

Zone 2: Limbus to a point 5 mm posterior into sclera

Zone 3: Posterior to the anterior 5 mm of sclera.

In closed globe injury,

Zone 1: External (limited to bulbar conjunctiva, sclera and cornea)

Zone 2: Anterior segment (including posterior lens capsule and parsplicata).

Zone 3: Posterior segment (all internal structures posterior to the posterior lens capsule).

EVALUATION OF TRAUMA

A careful history is extremely important in the evaluation of trauma. Specific questions should be asked concerning contact lenses, spectacles, or protective eyewear at the time of trauma and these items should be examined for damage.

Understanding of any preexisting ophthalmic disease or condition is important for risk assessment in ocular injury. Ophthalmic surgical procedures such as radial keratotomy, suggests an increased vulnerability of the eye to traumatic damage[3] or intraocular lenses because these may get dislodged or dislocated and complicate an otherwise straight forward injury.

Foreign – body injury

When foreign bodies are present or suspected, four major characteristics should be identified.

1. Source material
2. Origin
3. Probable trajectory
4. Risk of microbiologic contamination.

EXAMINATION

Conjunctiva

Subconjunctival hemorrhage is a common sequela of ocular injury although this condition is generally benign; hemorrhage may indicate underlying scleral injury. Conjunctival chemosis (jelly roll) is frequently associated with open globe injury[4].

Conjunctival lacerations may be isolated or multiple and may indicate underlying ocular damage. It is mandatory to explore all conjunctival laceration to look for the underlying scleral involvement.

Cornea

Corneal findings in trauma may be subtle. It is necessary to use a variety of slit-lamp illumination and inspection techniques during the examination. By narrowing the beam and directing the light source obliquely, the position of a foreign body within the corneal stroma can be detected. Similarly, the depth of a laceration or perforating injury can be estimated by using this narrow-beam, direct-illumination technique. Approximately 80% of intraocular foreign bodies enter the eye through the cornea[5].

Seidel's testing with or without provocation is helpful in deciding whether a full-thickness corneal laceration exists. Corneal wound may be with or without incarceration of tissues like iris, Lens and vitreous. In central wounds prolapse is unlikely but lens damage is common, whereas near limbus it is associated with prolapse of Iris.

Anterior Chamber

Evaluation of the anatomy should begin with an estimation of the depth and contour of the anterior chamber across its entire height and width. Areas of localized shallowing or irregularity should be noted because they can indicate underlying problems such as choroidal detachment or hemorrhage, iridocorneal adhesion with leakage of aqueous secondary to a corneal perforation. The chamber can be diffusely shallowed in conditions characterized by loss or misdirection of aqueous humor. Deepening of the anterior chamber can be seen with rupture of the posterior sclera and vitreous loss.

There may be presence of blood, lens fragments, vitreous or foreign bodies in the anterior chamber. Many foreign bodies that penetrate the cornea fail to become embedded in either the iris or the lens and fall to the 6 o clock position in the angle, and these foreign bodies are detected with the help of gonioscopy.

Iris

Inspection of the iris should begin with an evaluation of its overall contour. Small holes or perforations when present guide you to the tract of foreign body within the eye.

Irregular or elliptical pupil may indicate an occult scleral perforation with peripheral iris prolapse. Peaking of the pupil may indicate vitreous prolapse into the anterior chamber.

Lens

The position, stability, clarity and capsular integrity of the lens have to be ascertained by means of Slit-lamp biomicroscopy. Capsular perforation or rupture can cause regional opacification of the lens.

Owing to the antigenic nature of lens material, it is important to note lens disruption. If capsular discontinuities are not detected and lens rupture goes unnoticed, the resulting inflammation may be confused with infectious endophthalmitis.

Intraocular Pressure

Patients with globe rupture should not undergo IOP measurement for fear of extrusion of intraocular contents and contamination. All patients should have an IOP measurement after determining the globe is intact.

Vitreous and Retina

The evaluation should be directed specifically toward recognition of posterior scleral ruptures or discontinuities, foreign bodies, retinal edema, hemorrhage, tears or detachments and vitreous opacities.

Any site of retinal hemorrhage should be carefully inspected for the presence of a foreign body or occult rupture. Large proportions (70%) of intraocular foreign bodies are retained in the posterior segment[5]. Retinal incarceration and overlying retinal detachment in case of scleral rupture should be ruled out.

Ciliary body and choroids

Choroidal Hemorrhage or detachment may occur. Involvement of the ciliary zone considered to be the 'Dangerous Zone' can lead on to sympathetic ophthalmitis.

Sclera

It may be simple tear or associated with uveal or retinal incarceration or prolapse. Small anteriorly placed scleral wound have good prognosis. Large lacerations which extend posteriorly to involve retina and choroid have poor prognosis due to vitreous hemorrhage, retinal tear or detachment.

PATHOPHYSIOLOGY OF WOUND HEALING

(i) Corneal wound

A linear laceration of the cornea may seal spontaneously because of swelling of exposed corneal stroma. Rapid migration of epithelium serves to protect the underlying stroma from infection, drying or additional swelling. The surface contour will be reestablished by the epithelium despite a defect in the underlying stroma. Healing of the stroma is by means of new collagen produced by fibroblast[9]. The breach in Bowman's membrane is not reestablished and a new Descemet's membrane is formed posteriorly. The tensile strength of the cornea in the wound area is less than that of surrounding tissue. The scar tissue is translucent or opaque[10].

(ii) Scleral wound

The repair tissues originate from the fibrovascular components of the episclera and the uveal tract. The scleral fibroblasts appear to play only a minor role in scleral wound healing. With maturation of the wound the orientation of the healed fibers will come to resemble that of the original sclera more closely than is seen in corneal tissue.

(iii) Limbal wound

It combines the features of both corneal and scleral wound healing.

PRE - OPERATIVE MANAGEMENT

Once the surgical plan is decided after thoroughly examining the eye, a rigid eye shield should be applied over the injured eye to protect the eye from further damage. Associated vomiting and coughing should be minimized by appropriate drugs. Pressure on partially prolapsed intraocular contents can be prevented by administering a facial nerve block to eliminate squeezing and blinking.

Local or general anesthesia can be used depending on the mechanism of injury, the extent of ocular injury, the presence of coexisting medical injuries and age of the patient. The use of periocular anesthesia in ocular trauma is safe if performed with careful case selection[6, 7].

Prophylactic intravenous antibiotics consisting of vancomycin and a third generation cephalosporin are used to cover the most common gram positive and negative bacteria associated with post traumatic endophthalmitis. Vitreous penetration of these antibiotics following trauma is adequate for most gram positive organisms. Oral antibiotics that have good vitreous and intraocular penetration may be considered in outpatient settings particularly fluoroquinolones[8].

MANAGEMENT OF CORNEOSCLERAL LACERATIONS

The primary objective of surgery for penetrating corneoscleral injuries is complete, watertight closure of the globe with restoration of structural integrity. Secondary goals include removal of disrupted lens and vitreous, avoidance of uveal and vitreous incarceration in the wound, removal of intraocular foreign bodies, and restoration of normal anatomic relationships with minimal tissue distortion. Primary repair should be performed urgently but timing may be determined by extent of ocular involvement, concomitant bodily injuries, and general health status. For each day of delay in surgical repair there may be a reduced visual prognosis[11].

Simple Full – Thickness Corneal Lacerations

Simple corneal laceration is defined as one that does not violate the limbus and has neither iris, lens, or vitreous incarceration nor traumatic lens damage.

1. Bandage Soft Contact Lens

For small, self-sealing bevelled or edematous lacerations less than 3 mm in length a bandage lens may be sufficient to protect and support the wound as it heals. In cases that respond satisfactorily, the lens should be kept in place until the wound has stabilized, usually 3 to 6 weeks.

2. Tissue Adhesive

Cyanoacrylate tissue adhesive is useful for puncture wounds with small amounts of central tissue loss, stellate wounds with poor central apposition, selected small (< 2 mm) lacerations that do not self-seal, and those that would require excessive suture placement in the visual axis[12].

3. Corneal Sutures

Large lacerations (> 2 to 3 mm), displaced wounds, wounds with loss of corneal tissue, and lacerations with accompanying iris or lens incarceration require suturing of the wound.

A relatively watertight wound with a formed anterior chamber may be sutured directly. If the wound is less stable, a viscoelastic should be injected into the anterior chamber either directly through the wound or through a separate limbal stab incision to maintain the chamber and protect the lens, iris, and corneal endothelium. In many cases a limbal stab incision is preferable, because it is often less traumatic than repeatedly disrupting the wound edges with instruments and it will provide better access. Importantly, this site also may be used to sweep the wound and reposition of the iris if tissue incarceration supervenes.

Monofilament 10-0 nylon suture material on a fine spatula-design microsurgical needle is used for corneal suturing. These definitive corneal sutures should be approximately 1.5 mm long, approximately 90% deep in the stroma, and of equal depth on both sides of the wound. Conversely, full-thickness bites should be avoided, because the suture may act as a conduit for microbial invasion from the ocular surface[13]. Suture bites through the visual axis should be avoided. If suturing is necessary in the visual axis the bites should be made small, shallow and close to each other.

Stellate Corneal Lacerations

Achieving watertight closure of stellate lacerations and partial tissue avulsions presents a challenge. Techniques useful for a stellate laceration include multiple interrupted sutures, bridging sutures, and pursestring sutures.

Corneal Laceration with Iris Incarceration

If prolapsed, the tissue must be critically evaluated with regard to the advisability of tissue repositioning versus excision. Obviously devitalized tissue should be excised, as should extremely macerated, feathery, or depigmented iris. Tissue that has been prolapsed for over 24 hours generally should be removed to minimize infectious risks.

Viscoelastic injected through the wound or paracentesis site and directed toward the incarcerated iris may be effective in mobilizing the tissue. The mainstay of iris repositioning, however, remains direct sweeping with a spatula (e.g., cyclodialysis spatula or vitreous sweep). Care is taken to avoid causing iatrogenic iridodialysis or damage to the corneal endothelium and lens.

Corneal Laceration with Lens Involvement

Cataractous lens with anterior capsule disruption can be removed in the primary procedure; however, a stable lens with an intact capsule and without liberated cortical material can be treated in a secondary procedure. Phacoemulsification or small incision cataract extraction can be done keeping in mind that zonules may be weak.

Corneal Laceration with Vitreous Involvement

The primary goal in the emergency setting is to relieve any vitreous incarceration in traumatic wound. This helps prevent the associated complications of chronic inflammation, corneal decompensation, cystoid macular edema, vitreous fibrosis and retinal detachment, and infection mediated by a vitreous wick exposed to the environment.

Definitive attention usually is given to the vitreous after iris reposition and wound closure. After wound closure, fresh entry sites are made and necessary vitrectomy performed to clear the vitreous from the anterior chamber.

Simple Corneoscleral Lacerations

Lacerations extending beyond the limbus and into the sclera should be explored to delineate their full extent. The limbus is first approximated to restore correct anatomic relationships using nonabsorbable 8-0 nylon or silk sutures. Prolapsed iris is then reposited and the corneal wound closed. The extent of the scleral laceration is then ascertained and repaired appropriately. To stabilize the wound and prevent uveal prolapse during further exploration, it is helpful to place scleral sutures as soon as a new area of laceration is exposed. For scleral suturing, nonabsorbable sutures such as 8-0 nylon or silk are preferred.

A laceration extending behind the muscle may be sutured while the assistant retracts the muscle with the bridle suture or muscle hook. If the full extent of the laceration cannot be ascertained or suture placement is difficult, the muscle may be disinserted after being secured with a double-armed 6-0 which is subsequently used to reattach the muscle at its insertion.

Corneoscleral Lacerations with Uveal and Vitreous Prolapse

Vitreous prolapsing through a scleral wound is secured and gently withdrawn with dry cellulose sponges and cut flush with the sclera. Care is taken to avoid traction on the vitreous.

Uveal tissue often prolapses from gaping scleral lacerations. The preferred method of scleral closure over prolapsed uvea is a “zippering” technique[13]. In this technique the assistant depresses prolapsed tissue while the sclera is progressively closed proceeding posteriorly. Suture placement may be facilitated by passing the needle completely through one end of the sclera before the second pass. The sclera is then closed over the repositioned uveal tissue.

Corneoscleral Lacerations with Tissue Loss

For tissue loss, replacement techniques such as full-thickness and lamellar patch grafting are more appropriate. Grafts are preferable to direct suturing of poorly apposed tissue because of induced astigmatism. Patch grafting will achieve restoration of structural integrity while maintaining the anatomic relationships that will improve the ultimate outcome.

Irreparable Penetrating Injury

Severe corneoscleral lacerations are beyond repair. These cases include patients with severe loss of retinal tissue and those with profound destruction of the eye and require primary enucleation.

INTRAOCULAR FOREIGN BODY

Anterior segment intraocular foreign body

Most intraocular foreign bodies (IOFBs) are magnetic and are associated with activities involving striking metal against metal or the use of motorized machines. A minority are nonmagnetic substances such as glass, plastic, vegetable material or copper. It is necessary to remove the IOFB, although a glass, stone, sand, or plastic foreign body may be inert and well tolerated. Modern microsurgical techniques and instrumentation have reduced the operative risks and increased the efficacy of IOFB removal.

The iris may demonstrate a localized hemorrhage, distortion, or transillumination defect due to the presence or passage of the IOFB. Gonioscopy examination is important in localizing an IOFB in the angle of anterior chamber.

Treatment

Because most IOFBs are metallic, they should be removed to avoid the risk of toxicity. Iron containing retained IOFBs result in siderosis. Pure copper usually produces a suppurative response, and alloys of 80% copper or less may subsequently lead to chalcosis. Zinc and aluminium IOFBs are toxic and should be removed.

It is mandatory to remove vegetable IOFBs immediately because they usually contain microorganisms that can lead to endophthalmitis and cause excessive inflammation.

IOFB without Lens Involvement

If the IOFB spares the lens and remains anterior to the pupillary plane, the patient should not undergo further pharmacologic dilatation preoperatively.

The surgical incision depends on the location and size of the IOFB and other associated intraocular damage. Usually the anterior chamber is entered through a limbal incision. A foreign body lodged in or attached to the iris can usually be peeled loose by using viscoelastic dissection or by using a needle or hooked instrument to dissect and liberate it, taking care not to traumatize the lens.

IOFB with lens Injury

If the lens becomes disrupted and the foreign body is accessible the foreign body is removed and then routine cataract surgery is performed at the same sitting.

Posterior segment Intraocular Foreign Body

To perforate the eye and reach the posterior segment, a foreign body must have sufficient momentum and energy. Therefore, most posterior segment foreign bodies are metal fragments.

Ocular damage caused by an IOFB occurs by two mechanisms (1) mechanical damage due to the penetrating injury with its secondary complications and (2) the presence of the IOFB itself causing damage from microbial endophthalmitis, toxicity, or other inflammatory reactions.

Diagnosis and Localization

Direct visualization of the IOFB is by far the best diagnostic method[1].

Radiologic Imaging

Radiologic studies represent an important step in the initial evaluation of posterior segment IOFBs. Major advances have been made in the recent years in detection of IOFBs.

Plain Radiography

With the advent of modalities such as computed tomography (CT) and magnetic resonance imaging (MRI), the use plain radiography has diminished significantly. However it may be employed when these techniques are not readily available particularly to screen patients for the presence of metallic foreign bodies and to localize the IOFB with the help of limbal ring.

Computer Tomography

CT has replaced plain radiography as the preferred imaging modality for ocular and periocular trauma in the detection of suspected open globe, to determine the presence and location of suspected intraocular or intraorbital foreign bodies and to determine the presence and location of orbital fractures[14].

Magnetic Resonance Imaging

MRI is indicated to visualize periocular soft tissues and is contraindicated in patients with suspected magnetic foreign bodies.

Ultrasound

Ultrasound provides the greatest resolution and the most detailed anatomical information regarding the posterior segment of the eye compared to other image modalities. Ultrasound can give a general idea of the presence and relative position of a radio-opaque and radiolucent IOFB and is useful in eyes with opaque media[15].

Treatment

The decision to remove an IOFB and the timing of surgery depend on several considerations, including the nature and location of the IOFB, the type of injury, and other factors relating to a particular clinical situation.

In general, IOFBs of reactive substances such as iron or copper are considered toxic and should be removed promptly. Vegetable IOFBs present a high risk of microbial endophthalmitis and should also be removed as soon as possible. A less emergent approach can be used for non-reactive IOFBs.

External magnets

IOFBs suitable for an attempt at external magnetic extraction include small magnetic IOFBs and well-visualized IOFBs located in the vitreous or over the pars plana or retina.

(i) Direct approach

Conjunctival peritomy is performed. A full-thickness sclerotomy is then performed as close to the IOFB as possible. Diathermy is applied to the choroids, and a mattress suture is preplaced in the sclera.

The magnet is the applied directly over the choroids between the lips of the sclerotomy, the electromagnet is pulsed by turning it on and off. Pulsing minimizes heating, which interferes with the magnetic force. Sometimes the IOFB will be extruded through the choroids under the force of magnetization. However, incision of the choroids may be necessary to remove the IOFB.

As soon as the IOFB is extracted the sclerotomy site is closed and additional scleral sutures placed if necessary. Retinal tears are then treated appropriately, by cryo or laser.

(ii) Indirect approach

In this technique electromagnet is applied above the pars plana at a distance from the IOFB. This is indicated when the IOFB is located in the vitreous over the retina without evidence of retinal penetration.

The main complication of this procedure is lens or retinal damage caused by the rapid displacement of the magnetized IOFB during extraction. The risk of lens damage is greater when the magnet is applied from the opposite side, whereas the risk of retinal damage is greater when the magnet is applied to the adjacent side.

Vitrectomy

It is used in cases of nonmagnetic, large or subretinal IOFBs, eyes with opaque media or whenever IOFBs cannot be removed by a magnet. The goals of Pars plana vitrectomy are to clear the media opacities, remove the IOFB and repair any posterior segment damage such as retinal tear or detachment. During vitrectomy special attention is directed to removing the vitreous around the IOFB and relieving all adhesions. The goal is to free the IOFB from all vitreous attachments so that when it is grasped with forceps, no traction is transmitted to the retina with consequent iatrogenic retinal tear or break.

In subretinal IOFB, fibrous capsule which encapsulates the foreign body is incised with a sharp instrument to expose it, which is then grasped with serrated intraocular forceps. Retinal tears are treated with laser.

Several studies have shown no difference in visual outcome using an external electromagnet versus parsplana vitrectomy in removing IOFB[16]. However, refined PPV techniques have shown a propensity for improved visual outcomes and diminished rates of endophthalmitis[17].

PROGNOSIS AND OUTCOMES

Despite the advances in management, certain aspects of the injured eye have been known to carry a poor prognosis. Snell listed severe intraocular hemorrhage, endophthalmitis, severe prolapse of ocular contents and double perforating injuries as factors associated with a decreased likelihood of good visual function.

(i) Initial visual acuity

Visual acuity at the time of presentation appears to be the single most important factor in predicting final visual acuity in patients with penetrating eye injuries[18].

(ii) Afferent Pupillary Defect

Assessment of the pupillary function is critical in the evaluation of the open globe patients. In the setting of an irregular or fixed pupil in the injured eye the consensual response in the uninvolved eye can be used to determine relative afferent pupillary defect (RAPD by reverse)[19].

(iii) Size of Laceration

Large laceration >10mm was considered to be a predictor of poor visual outcome[20].

(iv) Location of Laceration

Laceration limited to the cornea carried the best prognosis followed by corneoscleral laceration and scleral laceration[20].

(v) Severe Vitreous Hemorrhage[21]

(vi) Presence of Intraocular Foreign Body

Modern surgical advances have led to improved modalities for managing foreign bodies so that eyes with intraocular foreign bodies now seem to carry a good prognosis. Whereas larger foreign bodies carries a poor prognosis due to the mechanical damage caused by the foreign body to the ocular structure[22].

COMPLICATIONS OF PENETRATING INJURIES

1. Non –Infectious uveitis

The most potent etiological factors are incarceration of uveal tissue in the wound, inflammation caused by free lens matter (endophthalmitis phacoanaphylactica) or persistent hemorrhage

2. Traumatic Cataract

3. Endophthalmitis

Most frequently caused by gram-positive cocci, Staphylococcus epdermidis. Traumatic endophthalmitis is unique in having a high incidence of Bacillus species in particular B. cereus[23, 24].There appears to be a strong association between B. cereus infections and retained metallic IOFBs, especially when associated with farm and soil related injuries.

Ultrasound evaluation may show anterior and posterior vitreous opacities and thickening of the retinochoroidal layer in endophthalmitis and may detect an occult IOFB.

Management

(i) Prompt collection of vitreous and aqueous specimens for culture, stain, and smear in all suspected cases.

(ii) Evaluation for intraocular foreign bodies by CT, X-ray, and ultrasound were indicated.

(iii) Systemic, periocular, and topical antibiotic prophylaxis in all cases of globe laceration, rupture, or penetration.

(iv) Intravitreal antibiotic therapy (in addition to systemic, periocular, and topical therapy) in all cases of suspected traumatic endophthalmitis and all cases of intraocular foreign body or soil-related injury.

(v) Vitrectomy offered to cases that has loss of red reflex or severe inflammation. Limited vitrectomy is preferred to minimize the risk of iatrogenic retinal detachment.

4. Sympathetic Ophthalmia

Sympathetic ophthalmia is characterized by granulomatous inflammation of the uvea following accidental or surgical penetrating injury to the globe. The inflammation appears in the injured (exciting) eye at a variable time after the injury and usually affects the contralateral (sympathizing) eye soon afterward. In the sympathizing eye the patient typically complains of pain, photophobia, and decreased visual acuity, associated with transient episodes of accommodative spasm, visual fatigue, and increased tearing.

Histopathologically, the uveal tract is thickened by a diffuse lymphocytic infiltrate containing epitheloid cells and giant cells that have phagocytosed pigment. Choriocapillaries and retina are not involved in the inflammatory response.

Treatment

Oral prednisone daily for the first week and then tapered based on the clinical improvement. Maintenance doses are frequently required to prevent recurrence.

In patients not responding to steroid treatment and in whom the use of steroids is contraindicated cytotoxic agents like methotrexate, cyclophosphamide, 2 mercaptopurine, azathioprine can be used and immunomodulators like cyclosporin A are showing good control of inflammation in these patients[25].

5. Traumatic cyst

Epithelial implantation cyst may form in the cornea, sclera, iris (Pearl cysts or serous cyst)[1].

6. Retained intraocular foreign body

Siderosis of the eye is due to the toxic effects from retained iron containing IOFB. It gets deposited intracellularly and causes toxic effects on cellular enzyme system[26].

Chalcosis of the eye is due to toxic effects from retained copper containing IOFB[27].

7. Tractional or Rhematogenous Retinal detachment

8. Corneal scarring, vascularisation and astigmatism

Patients with <3mm laceration usually have less astigmatism, whereas longer lacerations have >3.00D astigmatism. High amount of astigmatism may occur despite meticulous primary repair[28].

9. Secondary Glaucoma[29]

(i) Flat AC with formation of peripheral anterior synechiae

(ii) Inflammation

(iii) Intraocular hemorrhage, including hyphema and ghost cell glaucoma

(iv) Lens swelling with pupillary block

(v) Lens subluxation with pupillary block

(vi) Lens particle glaucoma

(vii) Phacoanaphylaxis

(viii) Posterior synechiae with papillary block

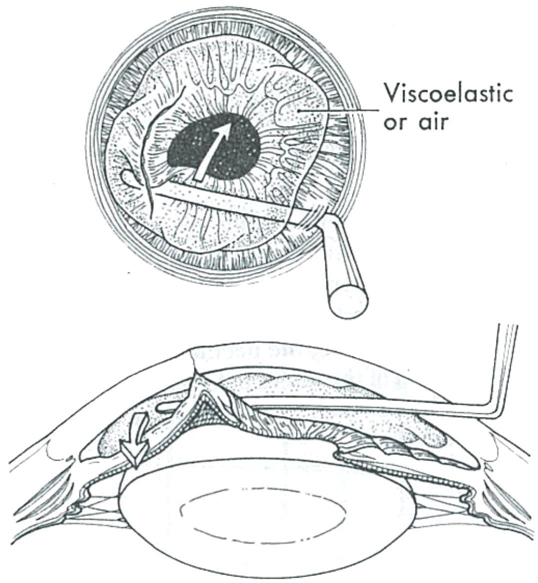
(ix) Epithelial downgrowth

(x) Fibrous ingrowth

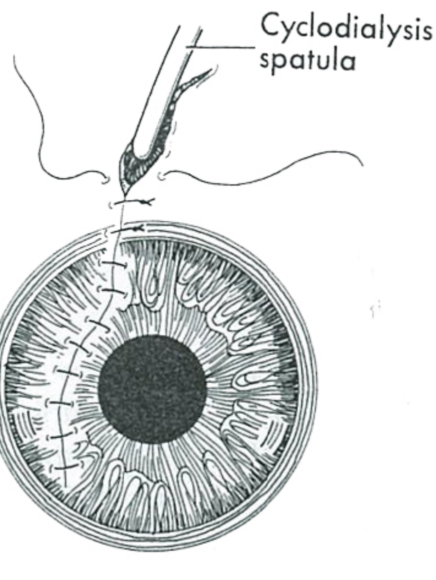
PREVENTION

Occupational open globe injuries are usually severe and are associated with a poor visual outcome. Important causes of occupational injuries are negligence and carelessness among the employees. Inadequate training in handling hazardous machineries can also lead to occupational injuries. Mandatory use of protective eyewear and alcohol free environment at the work place is likely to reduce the incidence of occupational open globe injuries. Creating awareness by educating parents and children about the injuries to the eye at home and during playful activities should be made an important public health goal[30].

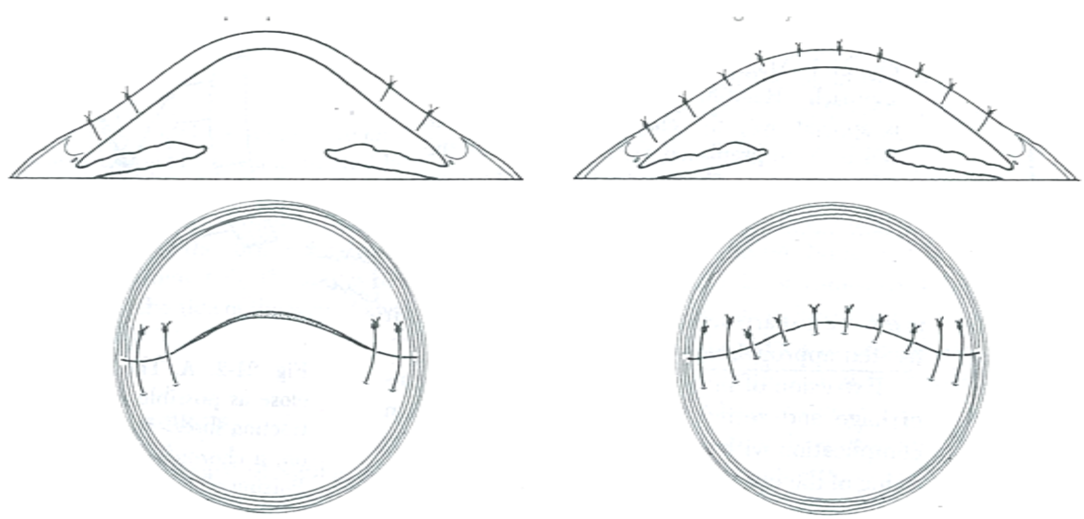
Most ocular injuries occur in predictable situations and hence are potentially preventable. As the primary provider of eye care, it is imperative that the ophthalmologist encourage the patient to avoid needless eye injuries by recognizing hazardous situations and adopting appropriate preventive measures and protective devices.

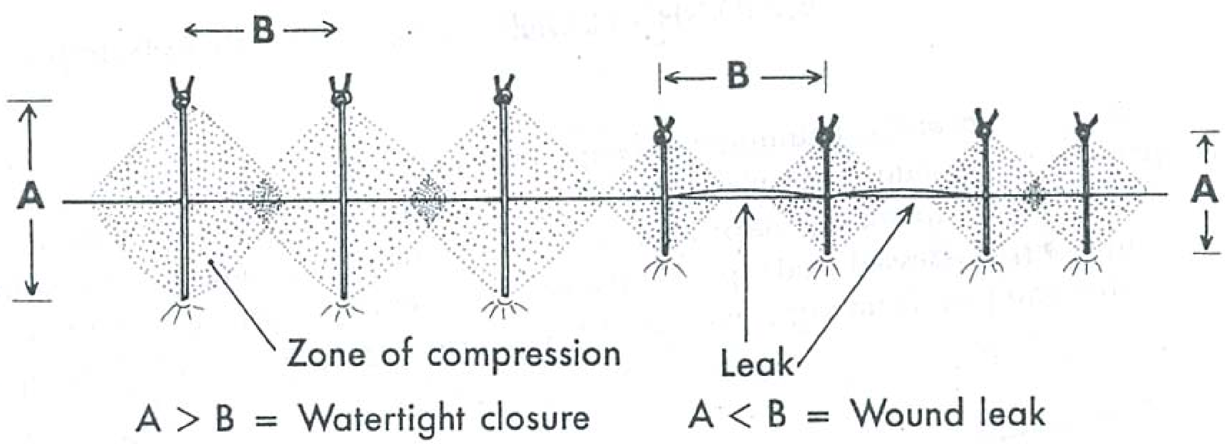


Technique of Iris Reposition

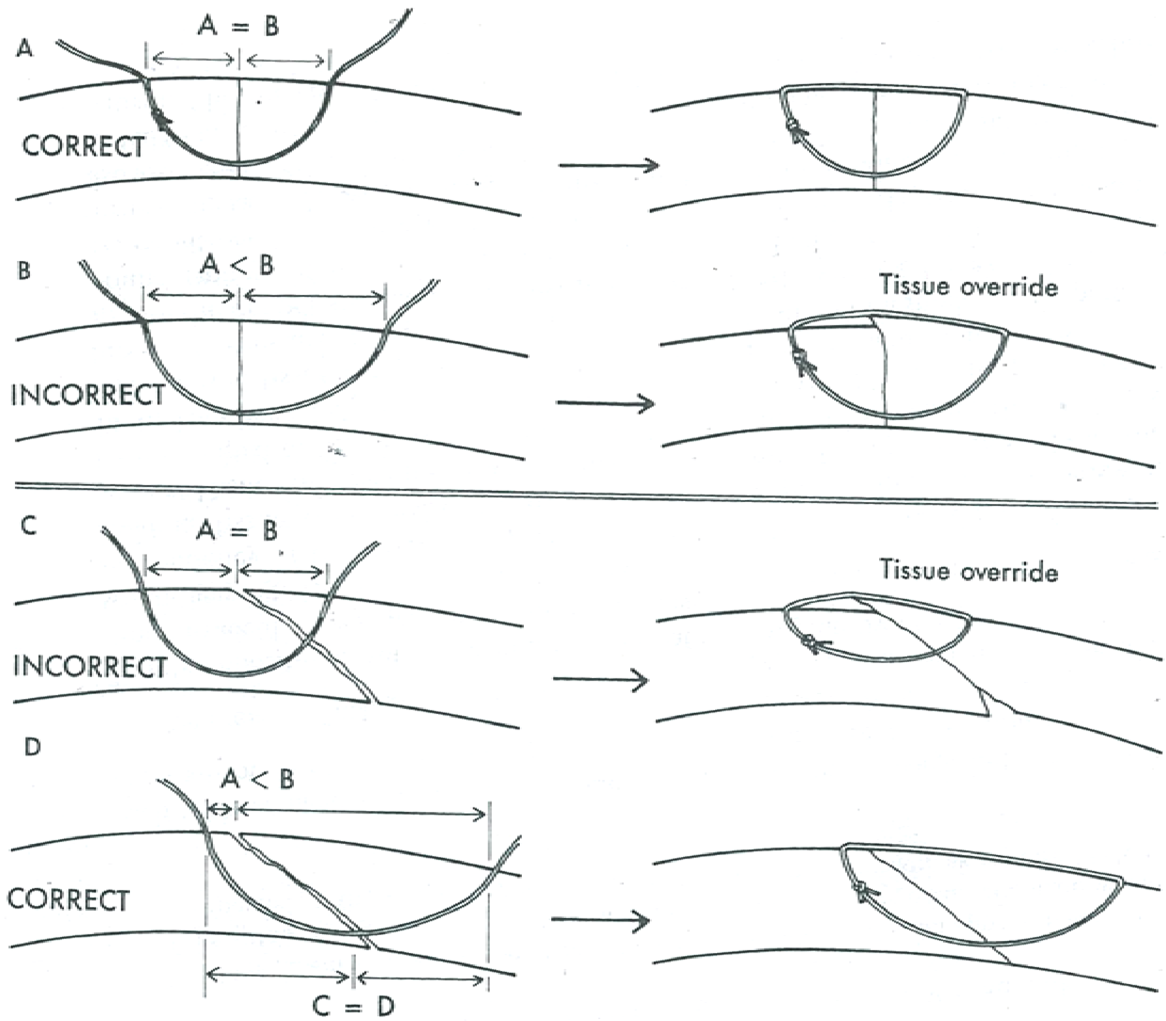


Zippering Technique of Scleral Wound Closure

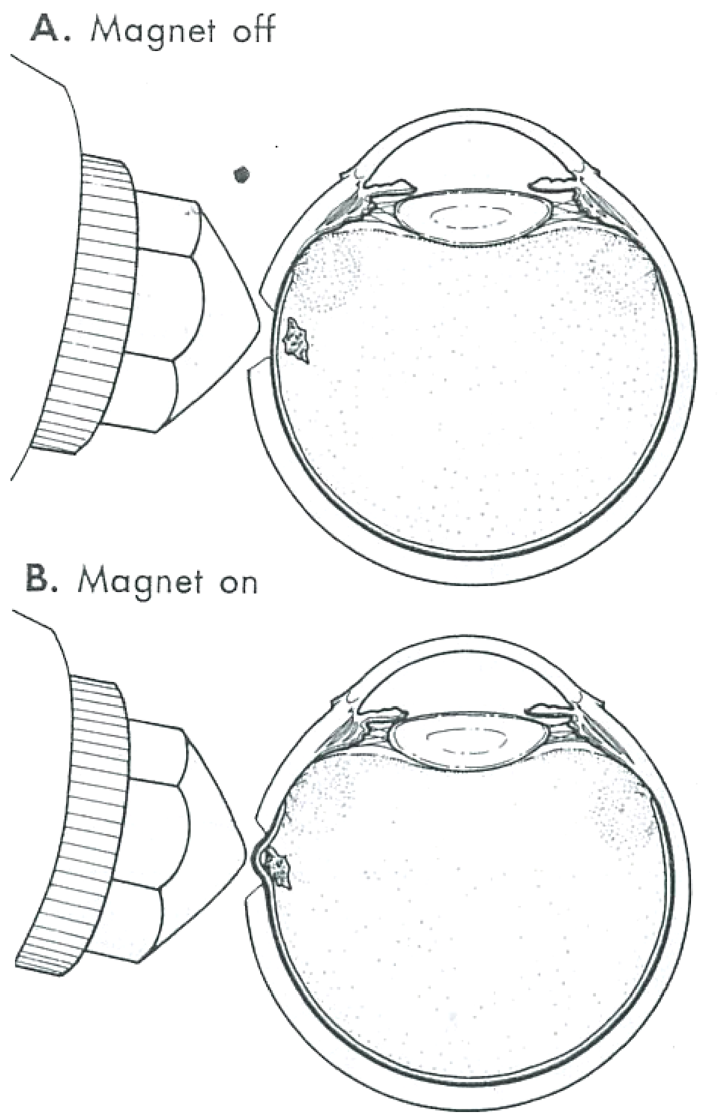




Techniques of Corneal Wound Suturing



Technique of Corneal Wound Suturing



Technique of IOFB Removal by Electromagnet (Direct approach)

AIM OF THE STUDY

i. To determine the incidence of penetrating injuries in various age groups.

ii. To analyse the mode of injury and object involved in penetrating injuries.

iii. To analyse the severity of penetrating injuries.

iv. To analyse the management of penetrating injuries.

v. To analyse the complications of penetrating injuries.

vi. To assess the visual prognosis in penetrating injuries.

MATERIALS AND METHODS

This study was conducted in Regional Institute of Ophthalmology And Government Ophthalmic Hospital, Egmore, Chennai from April 2009 to September 2010 for a period of 18 months.

INCLUSION CRITERIA:

Patients presenting to the outpatient department with open globe injury due to sharp objects were included in the study.

EXCLUSION CRITERIA:

Patients with open globe injury due to blunt trauma (Globe rupture) and with history of pre-existing posterior segment pathology were excluded from the study.

PRE-OPERATIVE ASSESSMENT:

A detailed clinical history regarding the mode of injury, objects involved, diminution of vision, time lapse between the occurrence of trauma and treatment were recorded.

Detailed ocular examination was carried out, this includes,

i. Visual acuity measurement using snellen’s chart

ii. Anterior segment examination by slit lamp biomicroscopy

iii. Posterior segment evaluation by direct and indirect ophthalmoscopy

iv. X-ray orbit to rule out fracture and IOFB

v. B-scan after restoring the globe integrity to find out posterior segment pathology

vi. IOP measurement by applanation tonometry after restoring the globe integrity in appropriate patients.

vii. Biometry for IOL power calculation

SURGICAL TREATMENT

Preoperative Preparation

Patients were given Tetanus prophylaxis and started on Intravenous antibiotics (inj. Cefotaxime 1gm bd)

Anaesthesia

Adults were operated under local anaesthesia and children under general anaesthesia.

Surgery

Patients presenting with tear were sutured in the primary procedure after clearing the wound site. Only those with disrupted anterior capsule, lens matter in anterior chamber and cataractous lens were taken for combined cataract extraction and IOL implantation along with wound repair.

The patients were started on topical antibiotics and steroids. Systemic antibiotics were given for a period of one week. All patients were subjected to X-ray orbit and B-scan to rule out the presence of IOFB and any posterior segment pathology.

Those who developed traumatic cataract were treated with cataract extraction and IOL implantation (PCIOL/SFIOL based on the posterior capsule intactness and zonular support) as a secondary procedure after controlling anterior segment inflammation.

Patients with intraocular foreign body were treated with foreign body removal either with giant magnet or with pars plana vitrectomy based on the magnetic property of the foreign body.

Post Operative Management

The patients were treated with topical and systemic antibiotic and steroids.

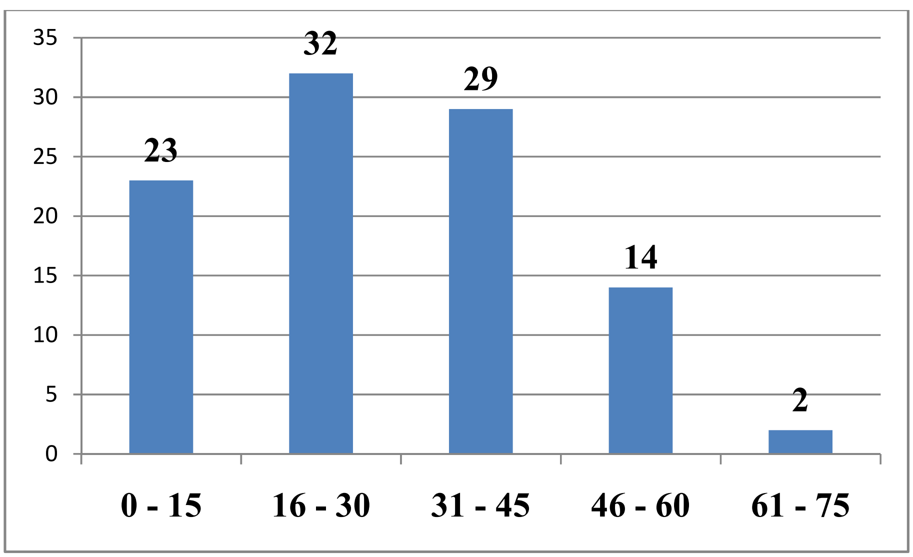
Post operative follow up

Patients were examined every day for three days and then every week for six weeks. Routine ocular examination was done during each visit. Sutures were removed at the end of six weeks and spectacle correction was given for residual refractive error.

OBSERVATION AND ANALYSIS

1. AGE DISTRIBUTION

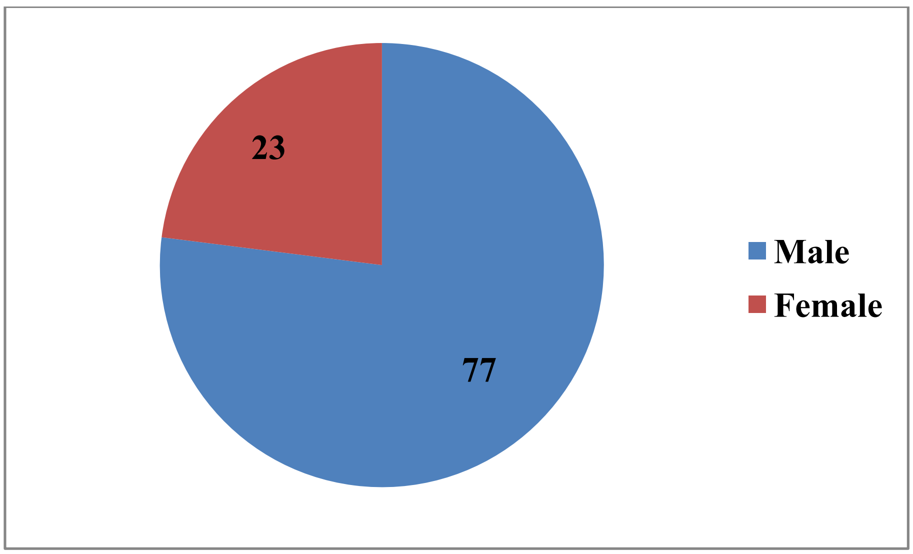
Age Group (Yrs)	No. of Cases	Percentage
0 - 15	23	23%
16 - 30	32	32%
31 - 45	29	29%
46 - 60	14	14%
61 - 75	2	2%



Incidence of ocular trauma is more in the age group of 16 to 30 years of age (32%) followed by age group of 31 to 45 (29%). Both together (16 to 45 years) constitutes about 61% of injuries in our study.

2. SEX DISTRIBUTION

Sex	No. of Cases	Percentage
Male	77	77%
Female	23	23%

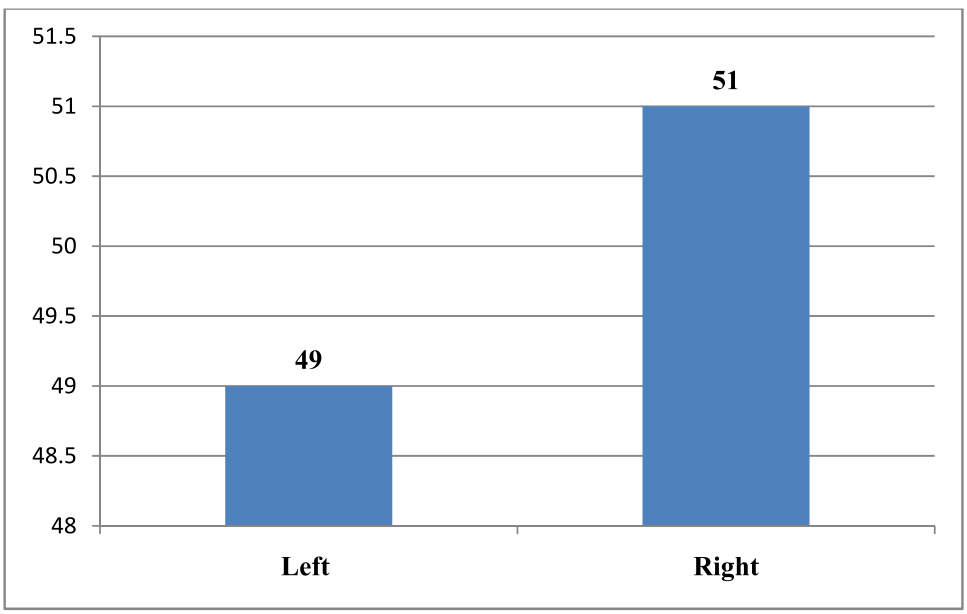


In our study, males were predominantly affected (77%)

Increased incidence in males is because of high percentage of males involved in outdoor activities.

3. LATERALITY

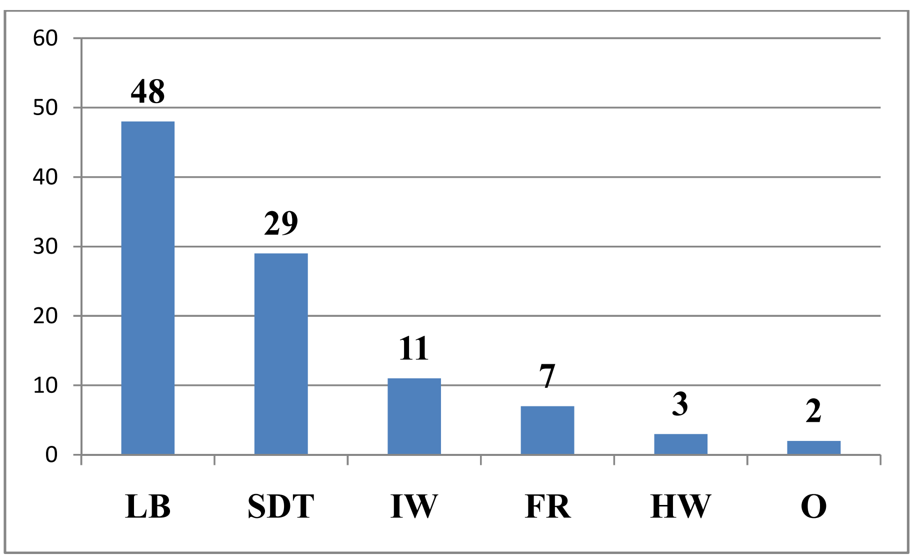
Laterality	No. of Cases	Percentage
Right Eye	51	51%
Left Eye	49	49%



In our study though the incidence of penetrating injury was more in the right eye (51%), there was no significant difference between the eyes involved.

4. OCCUPATION

Occupation	No. of Cases	Percentage
Labour (LB)	48	48%
Student (SDT)	29	29%
Industrial Worker (IW)	11	11%
Farmer (FR)	7	7%
House Wife (HW)	3	3%
Others	2	2%

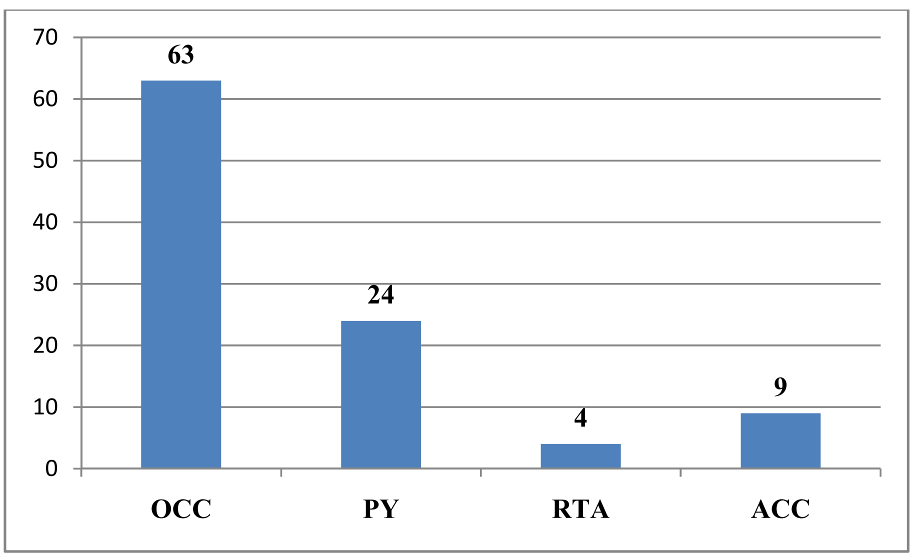


In our study the incidence of penetrating injury was common among manual labours (48%) due to the fact that none of them were wearing protecting eyewear.

29% of injuries were among students because of their involvement in sports and playful nature.

5. MODE OF INJURY

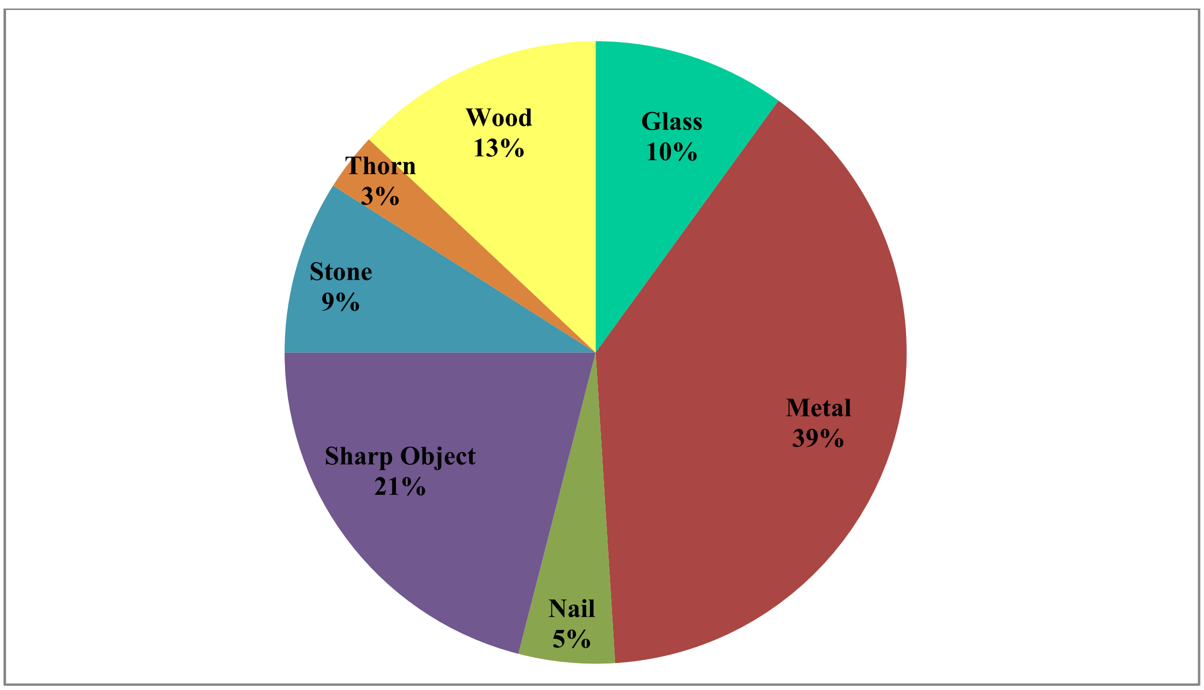
Mode of Injury	No. of Cases	Percentage
Occupation (OCC)	63	63%
Play (PY)	24	24%
Road Traffic Accident (RTA)	4	4%
Accidental (ACC)	9	9%



In our study 63% of penetrating injuries were occupational injuries.

6. SOURCE OF EYE INJURY

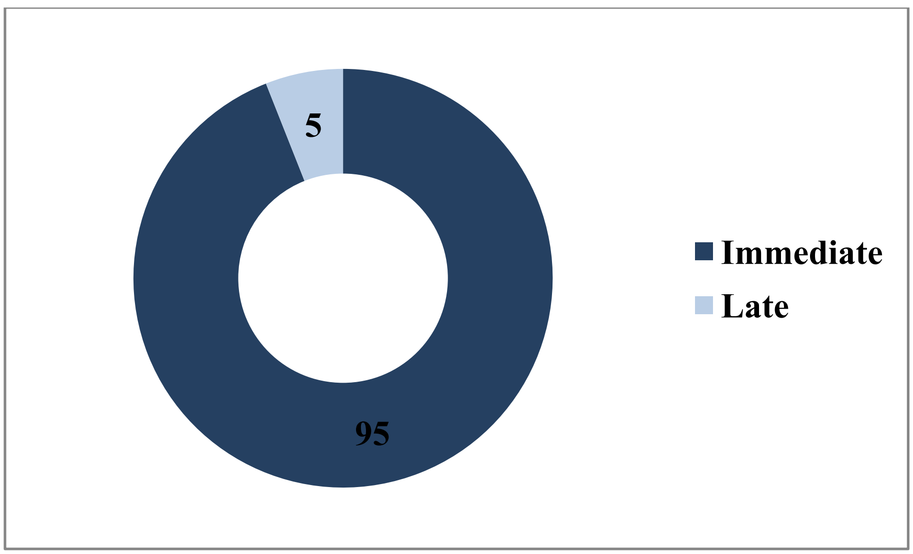
Object	No. of Cases
Metal	39
Glass	10
Nail	5
Sharp Object	21
Stone	9
Thorn	3
Wood	13



The commonest object causing penetrating injuries was metal (39%), because of their predominance in working environment.

7. TIME OF PRESENTATION

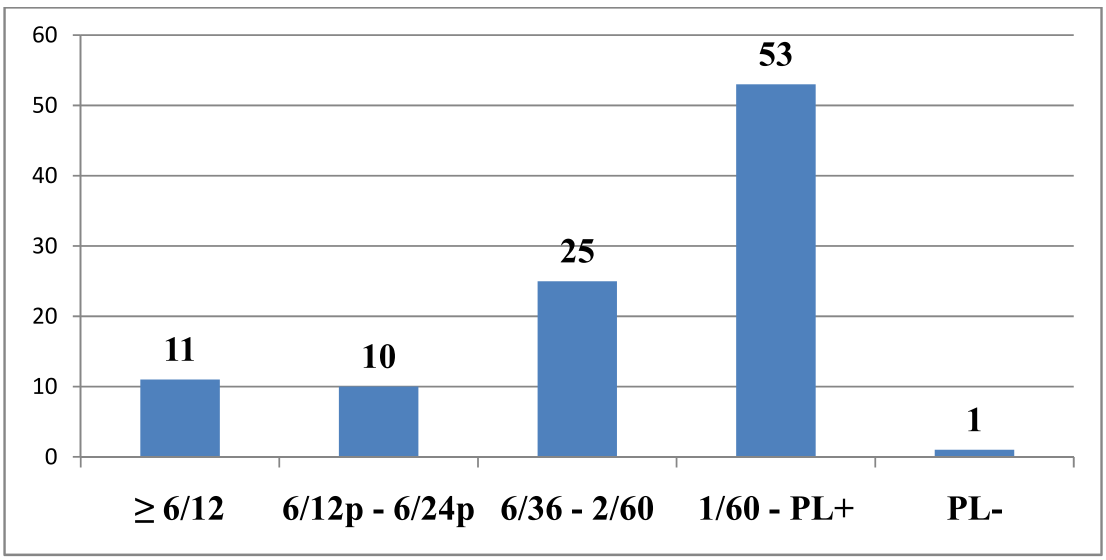
Time Interval	No. of Cases
Immediate	95
Late	5



In our study 95% of patients present to us within 24 hours of injury.5% of patients present to us over a period of 24 hours to 5 months after the trauma.

8. VISUAL ACUITY AT THE TIME OF PRESENTATION

Visual Acuity	No. of Cases
≥ 6/12	11
6/12p - 6/24p	10
6/36 - 2/60	25
1/60 - PL+	53
PL-	1



53 patients had a vision of 1/60 to PL+ (grade IV according to the Ocular Trauma Classification Group) at the time of presentation

25 patients had a vision of 6/36 to 2/60 (grade III)

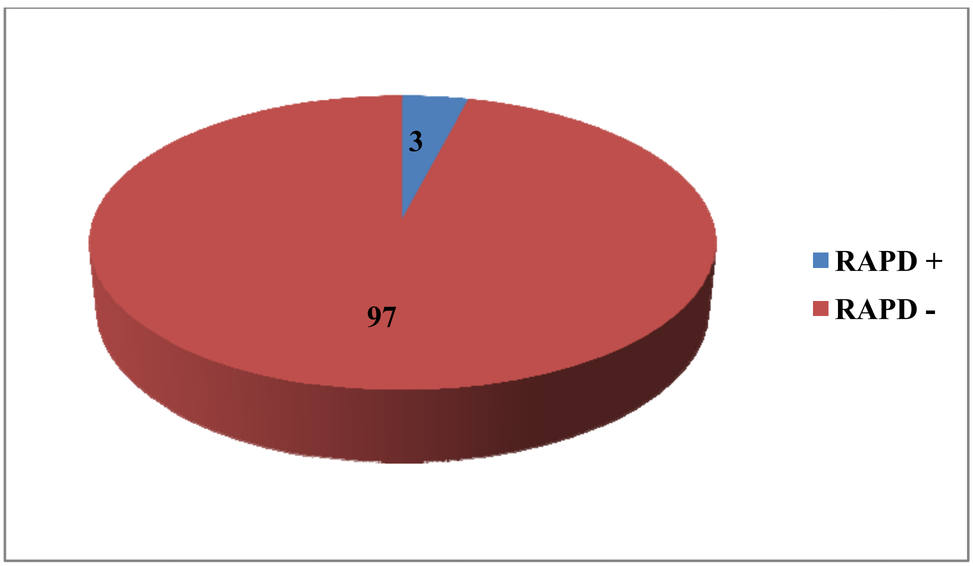
10 patients had a vision of 6/12p to 6/24p (grade II)

11 patients had a vision of ≥ 6/12 (grade I)

1 patient had no light perception (grade V)

9. RELATIVE AFFERENT PUPILLARY DEFECT

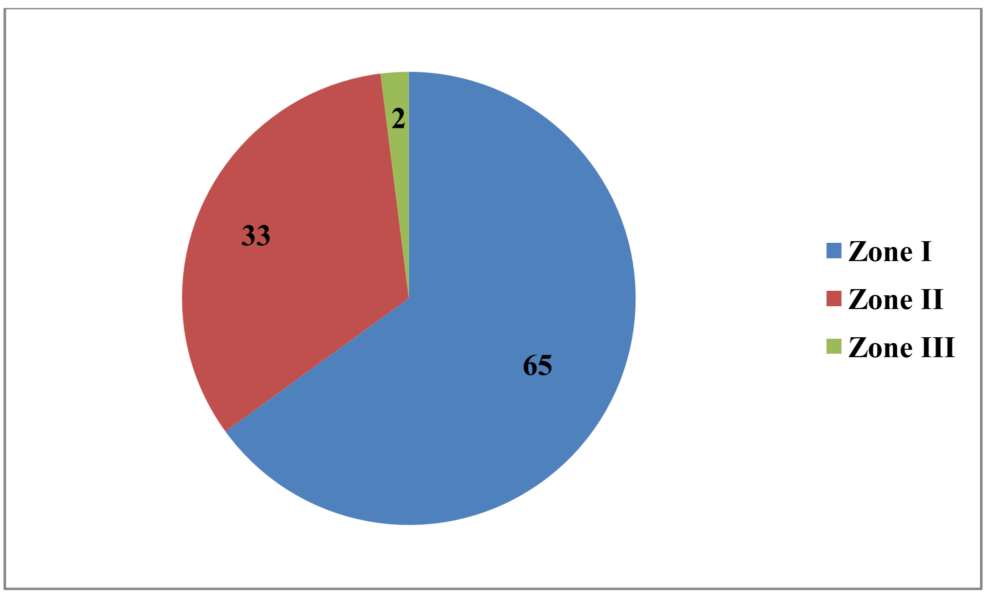
Pupillary Reaction	No. of Cases
RAPD +	3
RAPD -	97



In our study 3 patients had relative afferent pupillary defect in the injured eye.

10. LOCATION OF LACERATION

Location	No. of Cases
Zone I	65
Zone II	33
Zone III	2



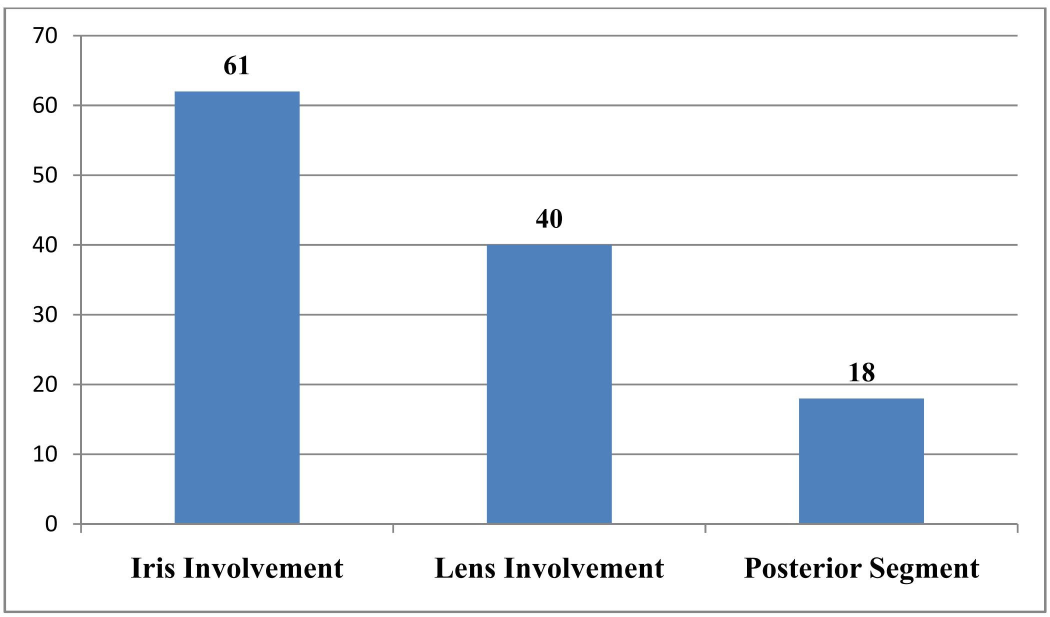
In our study 65% of patients had Zone I injury (isolated to cornea including the limbus, according to the Ocular Trauma Classification Group)

33% of patients had Zone II injury (within 5mm posterior to the limbus)

2% of patients had Zone III injury (posterior to the anterior 5mm of sclera).

11. ASSOCIATED OCULAR INJURIES

Associated injuries	No. of Cases
Iris Involvement	61
Lens Involvement	40
Posterior Segment	18



In our study Iris (61%) was the most commonly injured Intra Ocular structure in patients with penetrating injuries followed by Lens (40%)

Among the 61 patients with iris involvement 37 patients had Iris Prolapse, 18 patients had Iris Incarceration, 2 patients had Iris Hole, 2 patients had Iris Tear, 1 patient had Iridodialysis and 1patient had foreign body in the iris.

Among the 40 Patients with lens involvement 39 had cataractus changes and one had subluxation.

18 patients had posterior segment involvement in the form of vitreous haemorrhage, endophthalmitis, retinal detachment, choroidal detachment.

CORNEA

In our study 89 patients had corneal laceration of which 7 had simple corneal laceration, 8 patients had self sealed corneal laceration, 74 patients had corneal laceration associated with other ocular tissue injury.

ANTERIOR CHAMBER

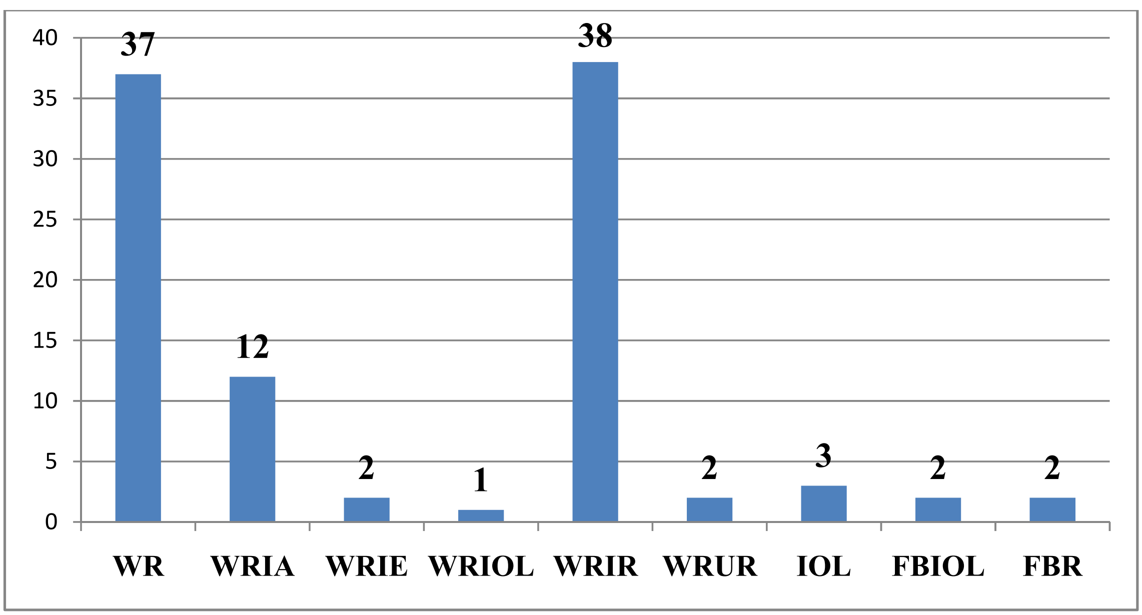
In our study 73 patients had shallow anterior chamber,15 patients had hyphaema, 3 patients had hypopyon, 3 patients had vitreous and 1 patient had lens matter in the anterior chamber.

SCLERA

In our study 35 patients had scleral laceration in which sclera alone is involved in 11 patients and 24 patients had associated corneal laceration.

12.PRIMARY PROCEDURE

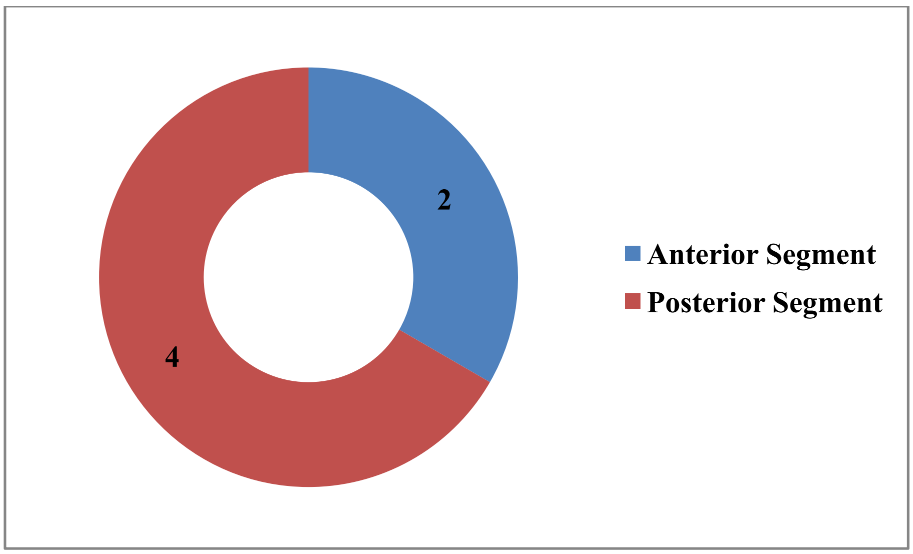
Surgery	No. of Cases
Wound Repair (WR)	37
WR with Iris Abscission (WRIA)	12
WR with Iris Excision (WRIE)	2
WR with Intra Ocular Lens (WRIOL)	1
WR with Iris Reposition (WRIR)	38
WR with Uveal Reposition (WRUR)	2
Intra Ocular Lens (IOL)	3
Foreign Body Removal & IOL (FBIOL)	2
Foreign Body Removal (FBR)	2



In our study 99 patients underwent Primary Procedure. 1 patient presented with the self sealed corneal tear associated with endophthalmitis, the patient was treated with intravitreal antibiotics.

13. INTRAOCULAR FOREIGN BODY

IOFB	No. of Cases
Anterior Segment	2
Posterior Segment	4



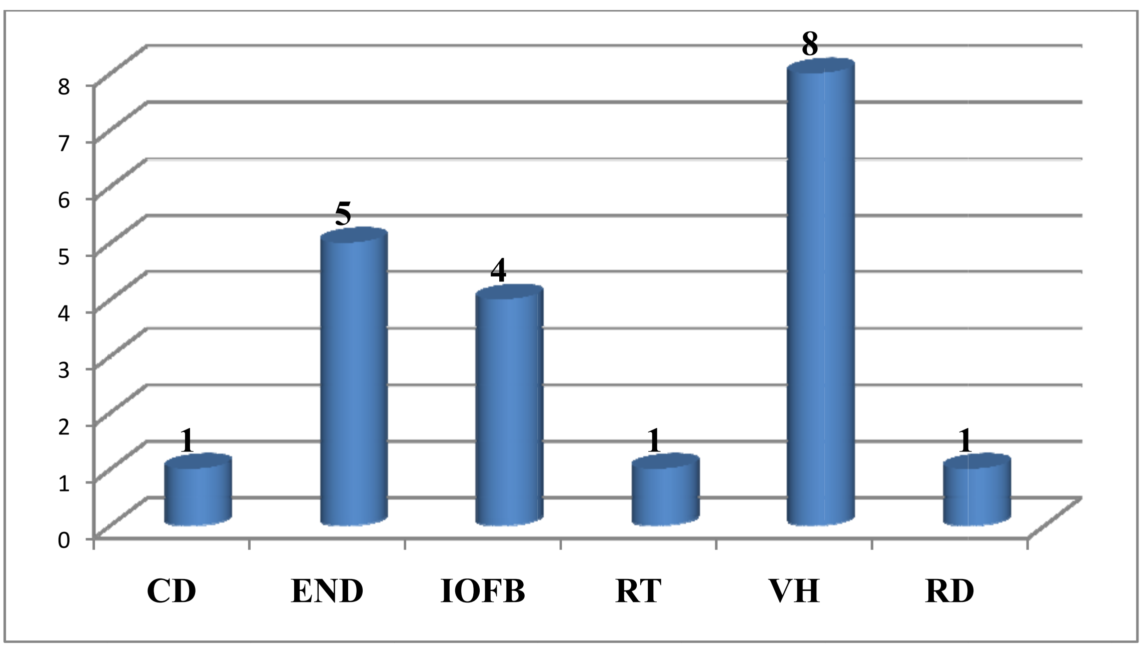
In our study 6 patients had intraocular foreign bodies of which 2 were in the anterior segment and 4 in the posterior segment.

Out of the two anterior segment foreign bodies one was in the Iris and the other one in the anterior chamber at 6 o'clock. Both of them were removed in the primary procedure through the limbal incision.

Of the four posterior segments foreign bodies three were removed with giant magnet and one with vitrectomy.

14. B-SCAN FINDINGS

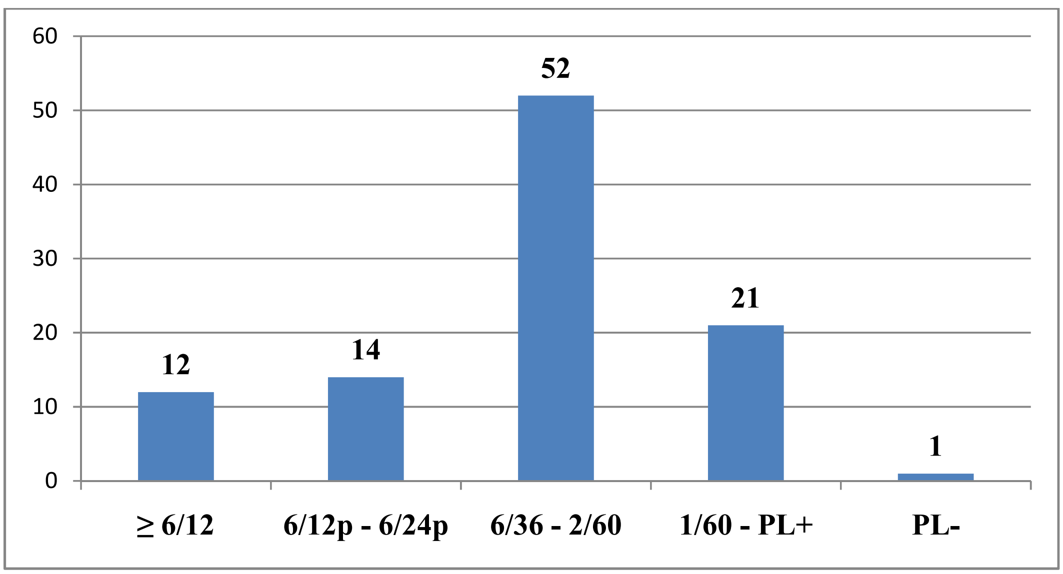
Findings	**No. of Cases**
Choroidal Detachment (**CD**)	1
Endophthalmitis (**END**)	5
Intraocular Foreign Body (**IOFB**)	4
Retinal Tear (**RT**)	1
Vitreous Haemorrhage (**VH**)	8
Retinal Detachment (**RD**)	1



In all other patients ultrasound B-scan showed normal posterior segment

15. VISUAL OUTCOME AT 3 DAYS POST OP

V/A 3 days Post Op (UCVA)	No. of Cases
≥ 6/12	12
6/12p - 6/24p	14
6/36 - 2/60	52
1/60 - PL+	21
PL-	1



After 3 days of surgery,

12 patients had vision of ≥ 6/12

14 patients had vision of 6/12p - 6/24p

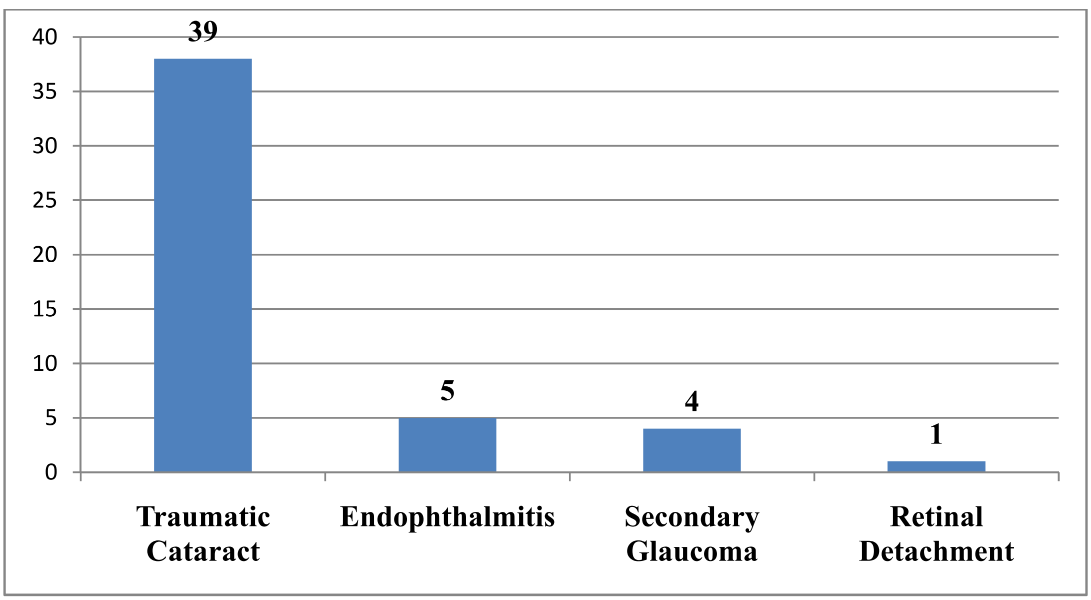
52 patients had vision of 6/36 - 2/60

21 patients had vision of 1/60 - PL+

1 patient had no PL

16. COMPLICATIONS

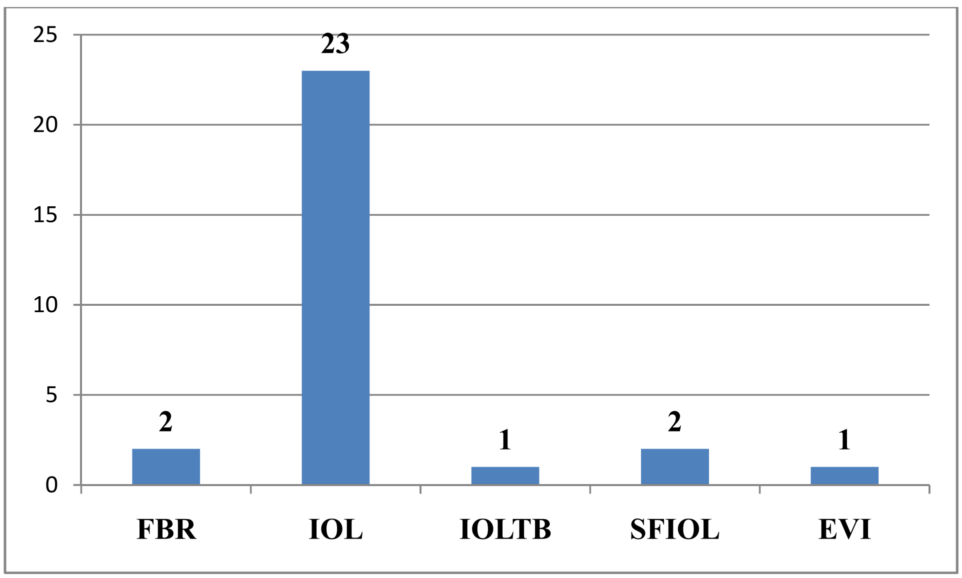
Complications	No. of Cases
Traumatic Cataract	39
Endophthalmitis	5
Secondary Glaucoma	4
Retinal Detachment	1



In our study Traumatic cataract (39%) was the most common complication. 5% patients had traumatic endophthalmitis.

17. SECONDARY PROCEDURE

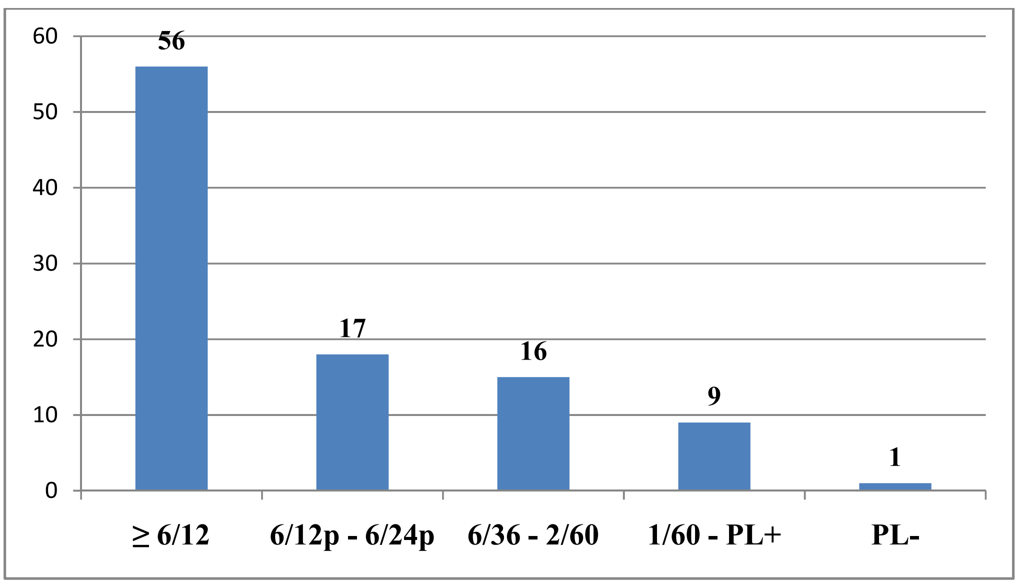
Surgery	**No. of cases**
Foreign Body Removal (**FBR**)	2
Intraocular lens (**IOL**)	23
Intraocular lens & Trabeculectomy (**IOLTB**)	1
Scleral Fixated IOL (**SFIOL**)	2
Evisceration (EVI)	1



In our study 25 patients underwent traumatic cataract extraction with intraocular lens implantation (23 patients were implanted PCIOL and 2 patients SFIOL) as a secondary procedure. One patient underwent cataract extraction with Trabeculectomy. Two patients underwent foreign body removal; one patient underwent evisceration for panophthalmitis.

18. VISUAL ACUITY AT 6 WEEKS POST OP

V/A 6 Weeks Post Op (BCVA)	No. of Cases
≥ 6/12	56
6/12p - 6/24p	17
6/36 - 2/60	16
1/60 - PL+	9
PL-	1



At the end of 6 weeks post operatively

56 patients had vision of ≥ 6/12

17 patients had vision of 6/12p - 6/24p

16 patients had vision of 6/36 - 2/60

9 patients had vision of 1/60 - PL+

1 patient had vision of No PL

DISCUSSION AND RESULTS

Incidence of penetrating injuries was more in the age group 16-45yrs (61%) which is due to the fact that people in active age group are more prone for injuries. Males (77%) were commonly affected because of the high percentage of males involved in outdoor activities. In Blomdahl and Norell study males were affected six times more common than females[31].

There was no significant difference between the eyes involved, Right eye was involved in 51% and Left eye in 49%. Incidence of penetrating injuries was common among Labours (48%) because of the fact that most of them were not wearing protective eyewear. Students (29%) are prone for injuries because of their playful nature and involvement in sports.

Occupational injuries (63%) were the most common mode of injury because of their exposure to hazardous machineries, which is high when compared to Schein et al who reported 48% of injuries in workplace[32]. Metal (39%) was the most common object causing penetrating injuries because of their predominance in working environment.

In our study 95 patients present to us within 24hrs of injury of which 76 patients (80%) improved to visual acuity >6/36 whereas 5 patients presented to us late (>24hrs) of which only one patient (20%) improved to visual acuity >6/36.

At the time of presentation (based on Ocular Trauma Classification Group)

53 patients had grade IV (1/60-PL+) visual acuity

25 patients had grade III (6/36-2/60)

10 patients had grade II (6/12p-6/24p)

11 patients had grade I (≥6/12)

1 patient had grade V (no PL)

Relative afferent pupillary defect was present in 3 patients, all of them had final visual acuity <1/60.

In our study, 65 patients had Zone I injury, 33 patients had Zone II injury, 2 patients had Zone III injury. Out of the 65 patients with Zone I injury 51 patients (78%) improved to visual acuity >6/36 at the end of six weeks post-op. Out of the 33 patients with Zone II injury 23 patients (69%) improved to visual acuity >6/36. Out of the 2 patients with Zone III injury only one (50%) improved to visual acuity >6/36. Hence Zone I injury has Good prognosis than Zone II and III. In Michel study laceration limited to the cornea (Zone I) carried best prognosis followed by corneoscleral and scleral laceration[20].

In our study, 99 patients underwent Primary procedure of which

37 patients underwent wound repair

52 patients underwent wound repair with iris repair (Reposition/Excision/Abscission)

3 patients underwent cataract extraction and IOL implantation

2 patients underwent wound repair with uveal reposition

2 patients underwent foreign body removal and IOL implantation

2 patients underwent foreign body removal

1 patient underwent wound repair with IOL implantation

Six patients had intraocular foreign body of which 2 patients had anterior segment foreign body and 4 patients had posterior segment foreign body. Both the anterior segment foreign bodies were removed via limbal incision. The final visual acuity was >6/12 in both the patients. Out of the 4 posterior segment foreign bodies 3 were removed with Giant Magnet and 1 via vitrectomy. Three patients had final visual acuity of >6/12 and one patient didn't show any improvement in visual acuity.

Traumatic cataract (39%) was the most common complication associated with penetrating injuries. Five patients had Post traumatic Endophthalmitis (5%) of which one patient had final visual acuity >4/60, remaining 4 patients had vision of <1/60. Briton et al reported 2-7% of post traumatic endophthalmitis in his study[33].

Four patients had secondary glaucoma because of intraocular inflammation in two patients, hyphaema in one patient and peripheral anterior synechiae in one patient.

Secondary procedure was done for 29 patients

25 patients underwent cataract extraction and IOL implantation

2 patients underwent foreign body removal

1 patient underwent cataract extraction with IOL implantation and Trabeculectomy

1 patient underwent Evisceration for Panophthalmitis

At the end of 6 weeks post-op

56 patients improved to vision ≥6/12

Among 10 cases with the vision <1/60, 3 patients had Endophthalmitis, 2 patients had corneal opacity in the visual axis, 3 patients had size of laceration >10mm, 1 patient had large IOFB. In Michel study laceration >10mm is found to be a predictor of poor visual outcome[20].

11 patients who presented with a visual acuity of ≥6/12 (grade I) have maintained their good vision (100%)

Among the 10 patients presented with grade II visual acuity all of them (100%) improved to ≥6/12

Among the 25 patients presented with grade III visual acuity, 20 patients (80%) improved to ≥6/12

Among the 53 patients presented with grade IV visual acuity, 16 patients (30%) improved to ≥6/12

One patient who presented with PL – (grade V) had no improvement

Hence Visual acuity at the time of presentation is an important prognostic factor. Michel study reported 97% of patients with initial visual acuity ≥5/200 regained final vision >5/200, whereas if the initial visual acuity was <5/200 there was only 36% chance of a final visual acuity >5/200[20].

CONCLUSION

In our study males were predominantly affected by penetrating injuries

The age group 16-45yrs was the most common group to get penetrating injuries.

The majority of penetrating injuries were occupational. Metal was the most common object involved in causing penetrating injuries.

Patients who presented immediately within 24hrs of injury had good visual prognosis than those presented late.

Though Wound repair is the most common intervention in the primary procedure some patients underwent cataract extraction and IOL implantation, foreign body removal.

Traumatic cataract was the most common complication associated with penetrating injuries. Five patients in our study had Endophthalmitis.

Cataract extraction with IOL implantation is the most common secondary procedure in our study.

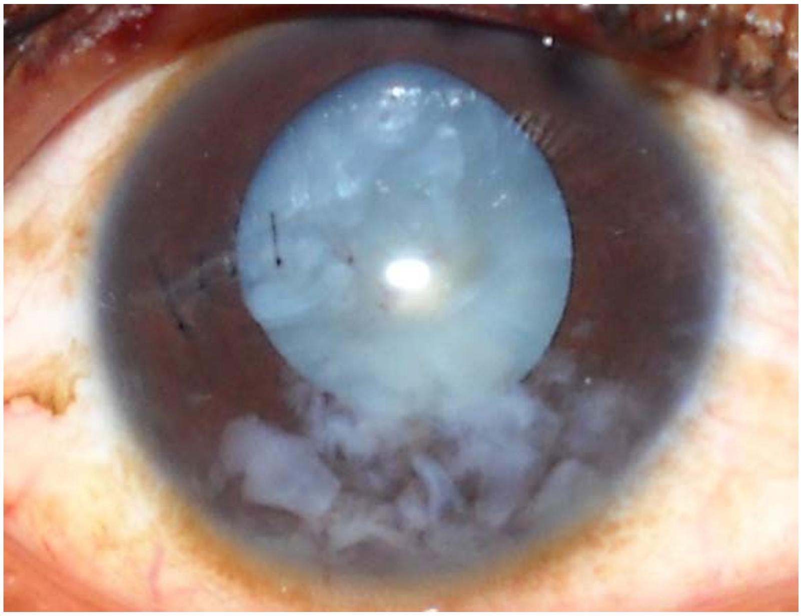
Visual acuity at the time of presentation is one of the most important prognostic factors in predicting visual outcome.

Patients who presented with RAPD had poor visual outcome.

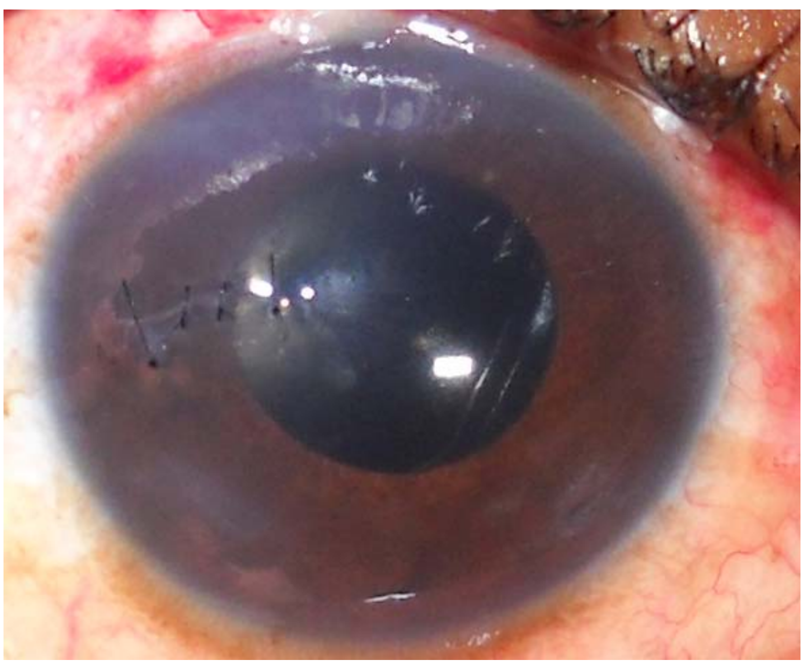
Zone I is the commonest location of laceration followed by Zone II and then Zone III. Patients who had Zone I injury had better visual prognosis than those with Zone II or Zone III injuries.

Visual acuity at the time of presentation, presence of Relative afferent pupillary defect, Zone of involvement and the size of laceration are the important factors in predicting the visual prognosis.

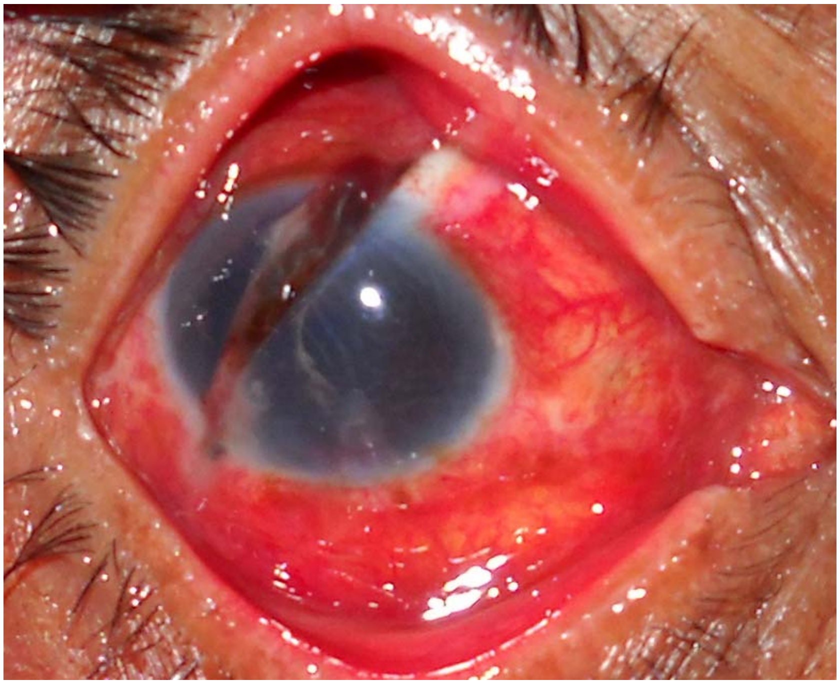
Importance should be laid on preventive measures by educating people on ocular trauma, use of protective eyewear and timely management.



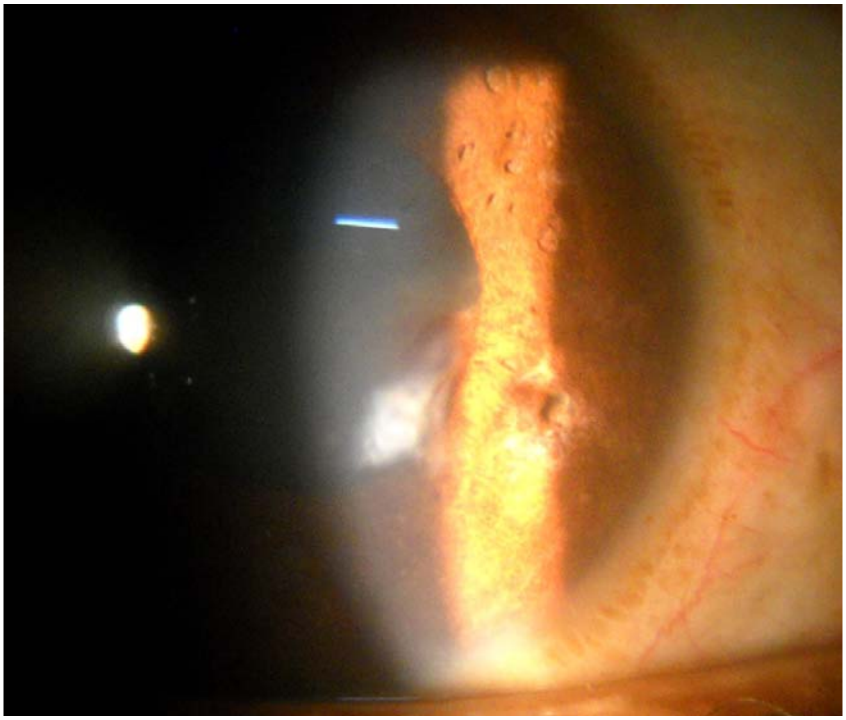
After Primary Procedure: Sutured Corneal laceration with Cataractous lens and lens matter in AC



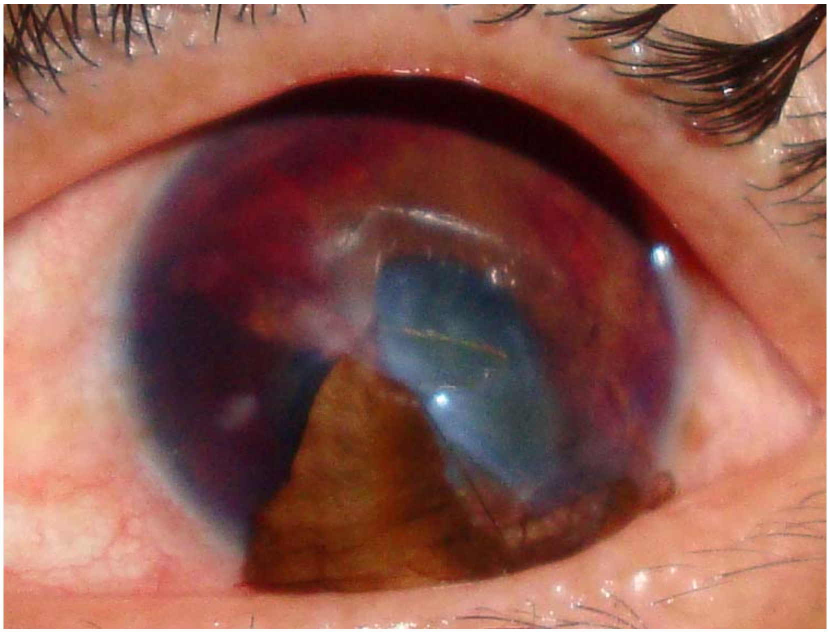
After Secondary Procedure: Cataract extraction and PCIOL implantation



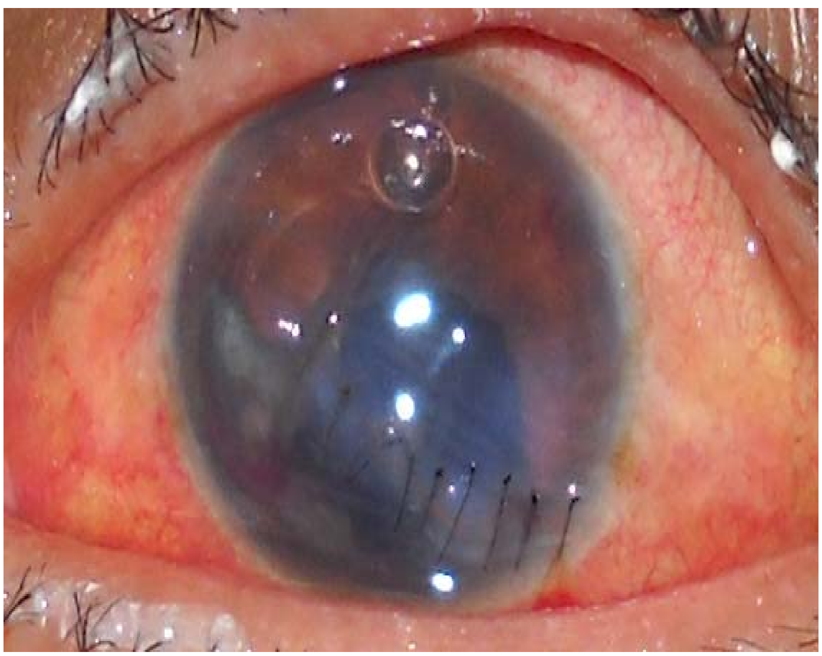
Corneoscleral laceration with iris prolapse



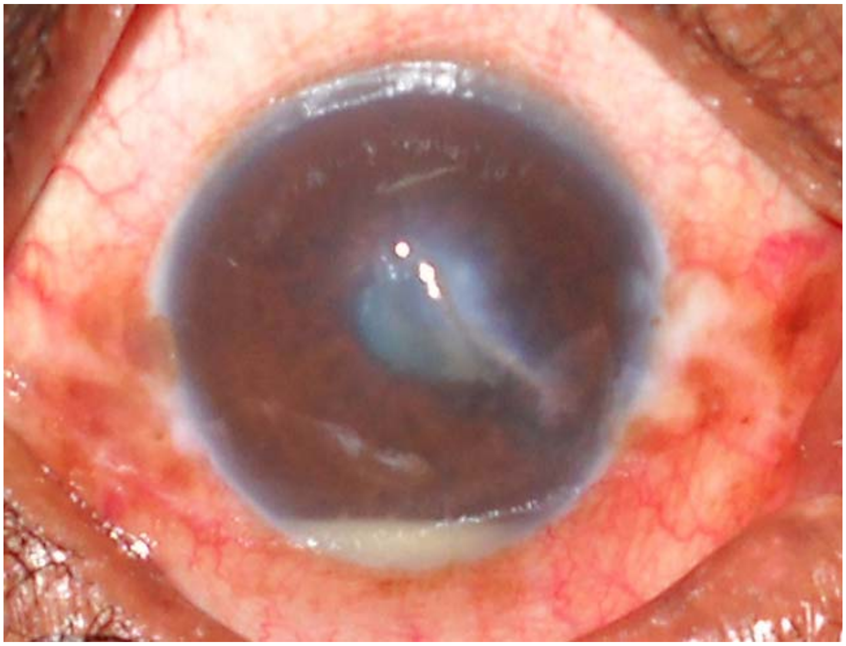
Self sealed corneal laceration with iris hole



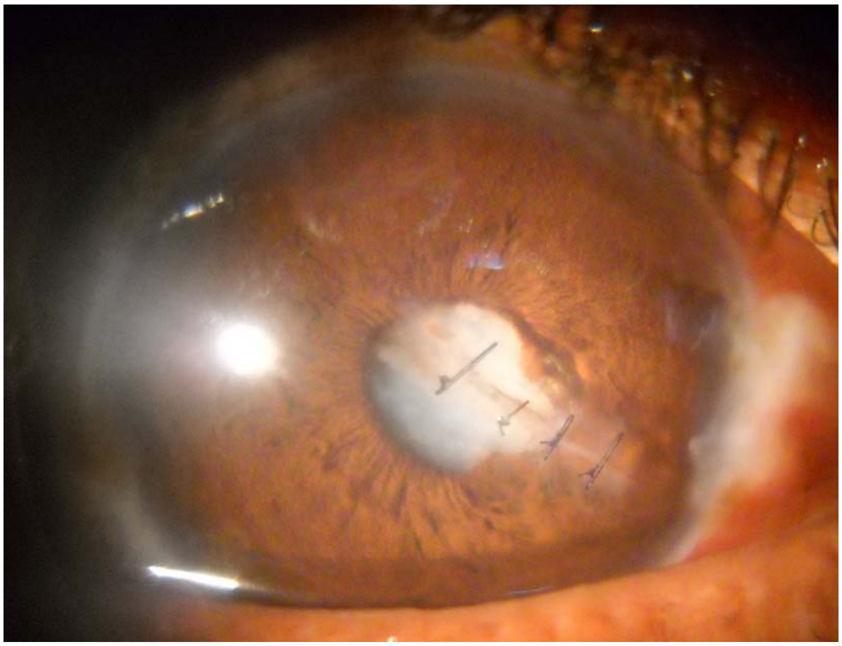
PRE-OP: Corneal laceration with iris prolapse



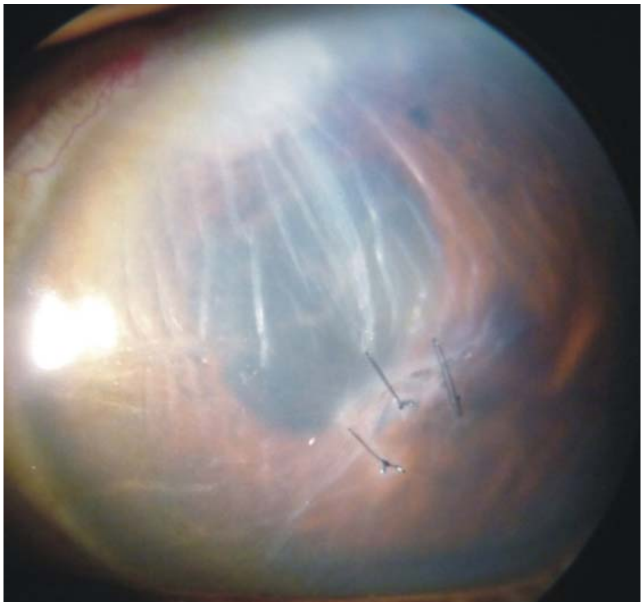
POST-OP: Corneal laceration sutured after iris abscission



PRE-OP: Corneal laceration with hypopyon

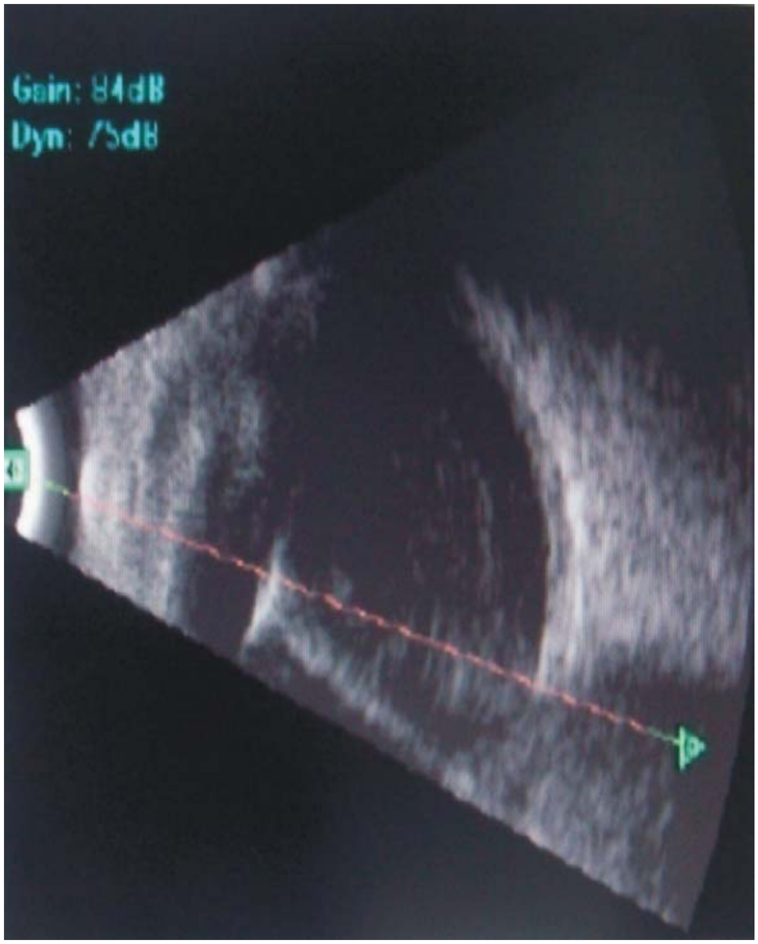


POST-OP: Corneal laceration sutured



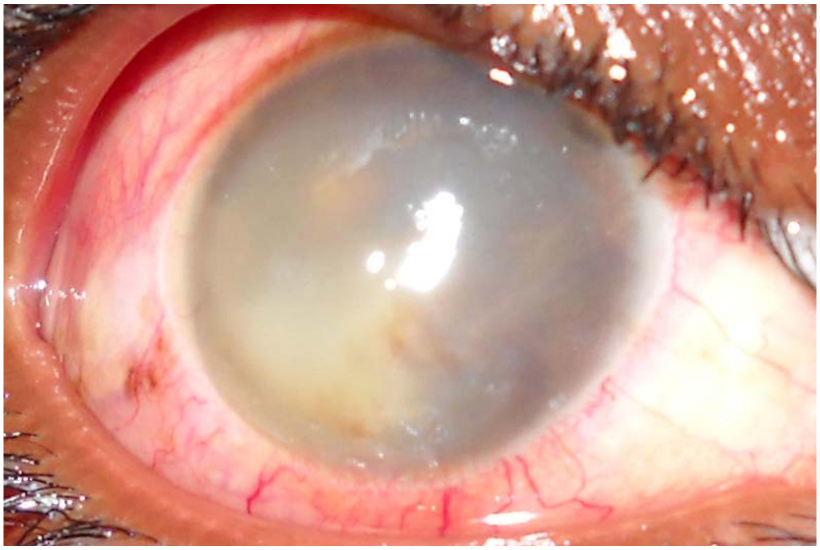
Sutured Corneal laceration

X-ray orbit PA & lateral view showing Radioopaque Foreign body in the Right orbital cavity

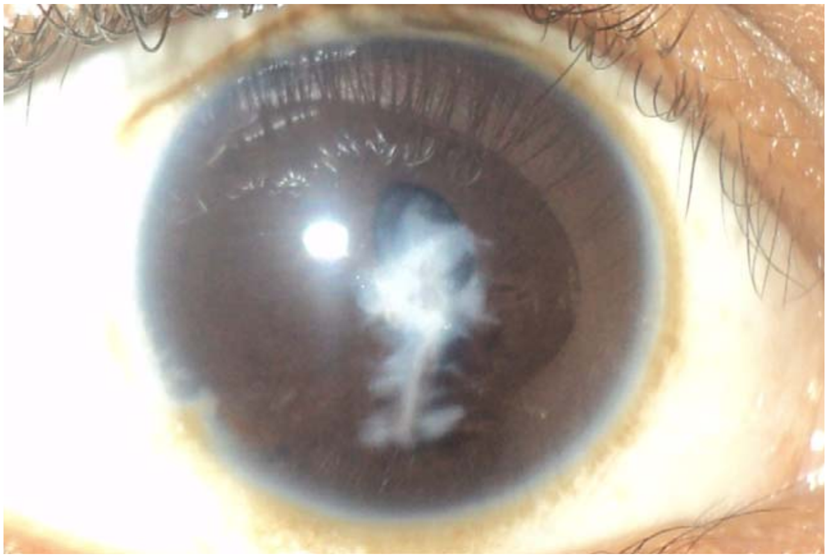


B-scan showing high reflective echo's in the vitreous cavity with after shadows in the Right eye

Removed Iron Foreign body



Post traumatic Endophthalmitis



Corneal Scarring in the Visual axis

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PROFORMA

1. Serial No
2. Name
3. Age
4. Sex
5. IP No.
6. Occupation
7. History
    a. Complaints (RE/LE)
        i. Injury
        ii. Defective vision
        iii. Redness
        iv. Watering
        v. Photophobia
    b. Mode of Injury
        i. Occupation
        ii. Road Traffic Accidents
        iii. Play
        iv. Accidents
    c. Object
        i. Metal
        ii. Wood
        iii. Stone
        iv. Glass
        v. Thorn
        vi. Needle
        vii. Nail

d. Treatment history

e. Past History: H/o any previous ocular surgeries

8. Ocular Examination :

a. Vision RE : With pH With pG

LE : With pH With pG

b. Slit Lamp Examination: RE LE

i. Conjunctiva
- Circumcorneal congestion
- Subconjunctival haemorrhage
- Laceration

ii. Cornea
- Laceration
- Edema
- Abrasion

iii. Sclera
- Laceration
- Uveal prolapse

iv. Anterior Chamber
- Depth
- Hypopyon
- Hyphaema
- Lens matter
- Vitreous

v. Iris
- Prolapse
- Incarceration
- Hole
- Tear
- Dialysis

vi. Pupil (RAPD) - present /absent

vii. Lens - Cataract
- Subluxation
- Dislocation

viii. Vitreous - Prolapse
- Incarceration

c. Fundus : RE LE

Direct

Indirect

Slit Lamp Biomicroscopy

d. Gonioscopy

9. Investigation

a) X-ray Orbit - PA and Lateral View

b) Ultrasound -

i. B-scan
- IOFB
- PC integrity
- Posterior segment pathology

ii. Biometry
- A scan
- K reading
- IOL Power

c) Other investigations –

i. Blood sugar - Fasting
Post prandial

ii. Urine Alb/Sugar

iii. Blood pressure

iv. Duct patency

10. Surgery (Primary Procedure)

i. Date of surgery

ii. Anaesthesia

iii. Type of surgery

11. Post Operative Treatment

12. Intra Ocular Pressure by Applanation

13. Complications

i. Traumatic cataract

ii. Glaucoma

iii. Endophthalmitis

14. Secondary Procedure

i. Date of surgery

ii. Anaesthesia

iii. Type of surgery

15. Post Operative Treatment

16. Follow up

i. Vision after 3 days

ii. Vision after 6 weeks

iii. Examination

KEY TO MASTER CHART

ABR	- Abrasion
AC	- Anterior Chamber
ACC	- Accident
CAT	- Cataract
CCC	- CircumCorneal Congestion
CD	- Choroidal Detachment
CFCF	- Counting Fingers Close to Face
CJT	- Conjunctival Tear
CONJ	- Conjunctiva
CTWT	- Corneal Tear with other Tissue involvement
DSL	- Dislocation
EDA	- Edema
END	- Endophthalmitis
EVI	- Evisceration
FBIOL	- Foreign Body Removal with Intraocular Lens
FBR	- Foreign Body Removal
FR	- Farmer
GL	- Glass
HM	- Hand Movements
HPO	- Hypopyon
HW	- House Wife
HYP	- Hyphaema
ID	- Iridodialysis
IH	- Iris Hole
II	- Iris Incarceration

IMM	- Immediate
IOFB	- Intraocular Foreign Body
IOL	- Intraocular Lens
IOLTB	- Intraocular lens and Trabeculectomy
IP	- Iris Prolapse
IT	- Iris Tear
IW	- Industrial Worker
LB	- Labour
LE	- Left Eye
LM	- Lena Matter
LT	- Late
ME	- Metal
N	- Negative
NA	- Nail
NL	- Normal
NV	- No View
OCC	- Occupation
P	- Positive
PL	- Perception of Light
PP	- Primary Procedure
PS	- Posterior segment
PY	- Play
RAPD	- Relative Afferent Pupillary Defect
RD	- Retinal Detachment
RE	- Right Eye
RT	- Retinal Tear
RTA	- Road Traffic Accident
SBL	- Subluxation

SCH	- Subconjunctival Haemorrhage
SCT	- Simple Corneal Tear
SDT	- Student
SFIOL	- Scleral Fixated Intraocular Lens
SH	- Shallow
SP	- Sharp
SP	- Secondary Procedure
SSCT	- Self Sealed Corneal Tear
ST	- Stone
ST	- Scleral Tear
TH	- Thorn
UI	- Uveal Incarceration
UP	- Uveal Prolapse
VH	- Vitreous Haemorrhage
VI	- Vitreous Incarceration
VT	- Vitreous
WD	- Wood
WR	- Wound Repair
WRIA	- Wound Repair with Iris Abscission
WRIE	- Wound Repair with Iris Excision
WRIOL	- Wound Repair with Intraocular Lens
WRIR	- Wound Repair with Iris Reposition
WRUR	- Wound Repair with Uveal Reposition