A CLINICAL STUDY OF PENETRATING EYE INJURIES

Dissertation Submitted for

M.S.Degree(Branch III) Ophthalmology

April 2013

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

CHENNAI

Dept. Of Ophthalmology

Govt. Rajaji Hospital

Madurai

CERTIFICATE

This is to certify that this dissertation entitled **"A CLINICAL STUDY OF PENETRATING EYE INJURIES** " has been done under my guidance in the Department of OPHTHALMOLOGY, MADURAI MEDICAL COLLEGE, MADURAI.

I Certify regarding the authenticity of the work done to prepare this dissertation.

Dr.P.THIYAGARJAN , M.S.,D.O.,
PROFESSOR & H.O.D
Dept. Of Ophthalmology
GOVT. RAJAJI HOSPITAL
MADURAI MEDICAL
COLLEGE,
MADURAI.

DECLARATION

I, **Dr. JULIANA ROSITTA STEPHEN**, Solemnly declare that the dissertation titled, "**A CLINICAL STUDY OF PENETRATING EYE INJURIES"** has been prepared by me.

This is submitted to the "**THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY, CHENNAI**, In partial fulfillment of the requirement for the award of M.S., (Ophthalmology) Branch-III degree examination to be held in **APRIL 2013.**

Place: Madurai

Date: **Dr. JULIANA ROSITTA STEPHEN**

ACKNOWLEDGEMENT

I am grateful to the Dean, Madurai Medical College and Govt.Rajaji Hospital, Madurai for permitting me to utilize the clinical materials of this hospital.

I am extremely grateful to ***Dr.P.THIYAGARAJAN, M.S.D.O.,*** Professor and Head of the Department of Ophthalmology, Madurai Medical College, Madurai, for his guidance and help for executing my study.

. I am extremely indebted to my beloved guide ***Dr.G.S.SRINIVASAN, M.S.,D.O.***, Professor of ophthalmology, Madurai Medical College, Madurai for his constant encouragement and guidance throughout this dissertation.

I am grateful to ***Dr.K.KAVITHA , M.S.,***Assistant Professor of ophthalmology for her valuable guidance, support and encouragement rendered to me during the study.

I am grateful to ***Dr.S.V.CHANDRAKUMAR , M.S.,D.O.,*** Assistant Professor of ophthalmology for his valuable guidance, support and encouragement rendered to me during the study.

My sincere thanks to all my Assistant Professors for their valuable suggestions in carrying out this study.

I thank my study subjects, who formed the back bone of this study and without whom this work would not have been possible.

Last but not the least, I thank “God the Almighty”, for being my guiding light all the way.

CONTENTS

PART – I

PART – II

INTRODUCTION

Ocular trauma is an important cause of preventable morbidity worldwide[1]. It is a major cause of acquired unilateral blindness and visual impairment. It constitutes about 1.5% of all the causes of blindness, 7% of all bodily injuries and 10-15% of all eye diseases. It is common in young males especially young adults. Since ocular injuries affect mostly the productive population, it causes a major socioeconomic loss.

Recently ocular trauma has gained more importance because of its increased incidence and advancement in the therapeutic approach. These have improved the prognosis. Ocular injuries can occur in any setting like recreational, sports activities, home, agricultural activities, at workplace and road traffic accidents. Penetrating ocular trauma caused by sharp objects and foreign bodies are considered as emergency. The availability of diagnostic modalities like CT, MRI and ultrasound have improved the assessment and management of trauma. The advent of microsurgical techniques and vitreoretinal surgeries has greatly improved the visual prognosis of the patients with ocular trauma.

Hence ocular trauma should be given greater importance. Nearly 90% of the eye injuries are preventable. Preventive measures should be taken in sports, agriculture and work related activities. People should be educated regarding the prevention of ocular injuries. Children should be supervised and taught about the dangers of sharp objects like pens ,pencils, scissors, compasses, etc. Glasses and sharp metals should be kept out of reach of children. Protective eye wears should be provided for people working with high speed grinders, cutters and in activities where there is risk of flying objects. Ophthalmologists play an important role in the management as well as prevention of ocular trauma. The adage 'PREVENTION IS BETTER THAN CURE' is apt for ocular injuries.

ANATOMY OF CORNEA

Dimensions

- The anterior surface of cornea is elliptical with an average horizontal diameter of 11.75mm and vertical diameter of 11mm
- The posterior surface of cornea is circular with an average diameter of 11.75mm
- Thickness of cornea in centre is 0.52mm and periphery is 0.67mm
- Anterior and posterior radii of curvature of central part of cornea are 7.8 and 6.5mm respectively.
- Refractive power of cornea is +43D and refractive index is 1.37

Histology

- The cornea consists of five distinct layers, from anterior to posterior are:
    1. Epithelium
    2. Bowman's membrane
    3. Stroma (substantia propia)
    4. Descemet's membrane
    5. Endothelium

Epithelium

Corneal epithelium is of stratified squamous type about 50-90µm thick consisting of 5-6 layers The deepest is the basal layer comprising of tall columnar cells arranged in palisade manner. It forms the germinal layer. The cells are firmly joined together by desmosomes and maculae occludens which accounts for the transparency and its barrier function. The wing cells forms 2-3 layers of polyhedral cells. The most superficial two layers consists of flattened cells. The anterior wall of these cells has many microvilli which play an important role in tear film stability.

Bowman's membrane

This layer consists of acellular mass of condensed collagen fibrils about 8-14µm thick. It shows considerable resistance to infection and injury. It does not regenerate.

Stroma

This layer is about 0.5mm thick and constitutes 90% of corneal thickness. It consists of collagen fibrils and cells embedded in hydrated matrix of proteoglycans.

The lamellae are arranged in many layers. They have oblique orientation in anterior one third. In the posterior two thirds, the alternating layers are at right angles to each other. The fibrils are mainly of type 1 collagen.

The cells present are keratocytes, lymphocytes and wandering macrophages, and histiocytes.

Descemet's membrane

It is a strong homogenous layer which binds the stroma posteriorly. It is made of collagen and glycoprotein with no elastic fibres. It can regenerate. In the periphery it terminates at the anterior limit of trabecular meshwork as Schwalbe's line.It is made up of type 1B collagen fibres arranged in a hexagonal pattern and embedded in matrix.

Endothelium

It consists of single layer of flat polygonal cells. The cell density of endothelium is 2400-3000cells/sq.mm. The endothelial cells are attached to Descemet's membrane by hemidesmosomes and laterally to each other by tight junctional complexes. This is calcium dependent and plays an

important role in barrier function. It has abundant mitochondria, free ribosomes, golgi complexes and smooth endoplasmic reticulum.

Blood supply

Cornea being avascular derives its nourishment from anterior ciliary vessels which invades its peripheral 1mm and diffusion from the aqueous humour. It gets oxygen supply from air in the central part whereas from the anterior ciliary vessels in the peripheral part.

Nerve supply

Cornea has rich sensory supply derived from long ciliary nerves, branches of nasociliary nerve-branch of ophthalmic division of trigeminal nerve. The long ciliary nerves run in the suprachoroidal space and pierce the sclera a short distance posterior to limbus to form annular plexus from which branches run radially to enter corneal stroma. The nerve fibres after losing their myelin sheaths form subepithelial plexus. Its fine terminal branches then pierce Bowman's membrane and between the epithelial cells they form intraepithelial plexus. They do not have specialized nerve endings or sensory organelles. The axons are devoid of Schwann cell sheath.

Corneal transparency

The main function of cornea is to act as a major refracting medium to form a clear retinal image.

Anatomical factors

1. Arrangement of stromal lamellae
2. Avascularity and nonmyelination of nerve fibres
3. Regular and uniform arrangement of epithelium and precorneal tear film.

Physiological factors

1. Stromal imbibition pressure
2. Barrier function of epithelium and endothelium
3. Hydration control by active metabolic pump
4. Evaporation from surface of cornea

Epithelium

The transparency of corneal epithelium is due to the homogenecity of the refractive index throughout the cellular layer. Normal precorneal tear film also plays an important role.

Avascularity and non myelination of nerve fibres

The cornea is normally avascular except for capillary palisade at limbal margin. Corneal vascularisation is always pathological. The cornea gets a rich sensory supply through long ciliary nerves which lose their myelin sheath within 1-2mm from limbus.

Arrangement of stromal lamellae

Maurice theory:

Collagen fibres are arranged in a uniform and regular lattice so that scattered light is destroyed by mutual interference. Cornea remains transparent as long as the fibres are regularly arranged and separated by less than a wavelength of light.

Goldmann theory

Corneal transparency is because fibrils are small in relation to light and do not interfere unless they are larger than one half of the wavelength of light.

Stromal imbibition pressure

It is the pressure exerted by glycosoaminoglycans of corneal stroma. The electrostatic repulsion of glycosoaminoglycans expands the tissue sucking in fluid called imbibition pressure.

Barrier function of epithelium and endothelium

The epithelium and endothelium are semipermeable and acts as a barrier to diffusion of sodium chloride and urea and to the flow of water. The barrier function of endothelium is calcium dependent.

Hydration control by active pump: Corneal endothelium plays an important role in controlling fluid transport due to severe enzyme pumps. The pump mechanisms require energy and are Na-K ATPase pump, bicarbonate dependent ATPase, carbonic anhydrase enzyme and Na/H pump.

Evaporation of water from the corneal surface: The evaporation of water from the precorneal tear film concentrates this fluid and increases its osmolarity. This hypertonicity draws water from the cornea.[2]

CORNEAL WOUND HEALING

CORNEAL EPITHELIAL WOUND HEALING

Latent phase (4-6 hours): Epithelial debridement incites polymorphonuclear leucocyte invasion which removes the necrotic debris. This causes retraction of epithelial cells, reduction of hemidesmosomal attachments in turn commencing lamellipodial and filopodial extensions.

Cell migration and adhesion (24-36 hours): Migration of epithelial cells is by changes in cytoskeletal and cell shape which involves redistribution of actin-myosin filaments. Actin filaments accumulates at the leading edges of lamellipodial and filopodial extensions. Migration is also dependent on matrix induced intracellular signaling through components like fibronectin, laminin and collagen peptides. Fibronectin causes centripetal migration of

leading epithelial cells across stromal surface thus completing the epithelial monolayer covering the wound area. This is followed by disappearance of fibronectin. Adhesion of epithelium to basement membrane and Bowman's membrane is via hemidesmosomes, lamina densa and type 7 collagen fibres.

Cell proliferation (36 hours to several months): The mitotic activity in the epithelium takes place at the limbus. The limbal stem cells produce transient amplifying cells which give rise to post mitotic cells. Post mitotic cells give rise to terminally differentiated cells which causes establishment of hemidesmosomes and possible epithelial hyperplasia.

STROMAL WOUND HEALING

Stromal wounds take longer time to heal because of its avascularity. The immediate effect of an incisional injury to the stromal matrix is wound gaping and imbibition of water to become opaque. This is followed by a series of events like fibrin deposition, rapid epithelization and activation of keratocytes undergo fibroblast transformation. Fibroblasts produce collagen, glycoproteins and proteoglycans which causes formation of extracellular

matrix. The newly formed collagen fibres are larger in diameter than normal because of high concentration of chondroitin sulphate and dermatan sulphate. This contributes to disruption of corneal transparency and scarring. Corneal stromal remodelling is controlled by various metalloproteinases.

ENDOTHELIAL WOUND HEALING

Endothelial cells have very minimal capacity to undergo mitosis. It is dependent on enlargement and movement of surrounding cells to cover the wound site. The direct response to injury is cell slide. If sufficient number of cells are lost then its pump fails and cornea imbibes water and becomes opaque.

The various growth factors playing important role in regulation are epidermal growth factor, fibroblast derived growth factor, platelet derived growth factor, insulin derived growth factor and transforming growth factor.[2]

ANATOMY OF LIMBUS

Anatomically Limbus refers to circumcorneal transition zone of conjunctivocorneal and corneoscleral junction.

At the conjunctivocorneal junction, the bulbar conjunctiva is firmly adhered to the underlying structures. The epithelium becomes several layers thick and are irregularly arranged at the limbus. At the sclerocorneal junction transparent corneal fibres becomes continuous with oblique, circular and opaque scleral fibres.

SURGICAL LIMBUS:

It is 2mm zone characterized by the following landmarks:

The anterior limbal border: It is the anterior boundary and marked by a prominent ridge which is created by insertion of conjunctiva and Tenon's capsule into cornea. It overlies the termination of Bowman's membrane.

Blue limbal zone: It is bluish transparent zone of variable width due to the position of insertion of conjunctiva and Tenon's capsule. It is 1mm superiorly, 0.8mm inferiorly and 0.4mm nasally and temporally.

Midlimbal zone: It is junction of blue zone with white area and overlies Schwalbe's line.

Posterior limbal border: It lies about 1mm posterior to midlimbal line. It overlies scleral spur.

White limbal zone: Lies between mid limbal line and posterior limbal border. It overlies trabecular meshwork.[2]

ANATOMY OF SCLERA

Sclera is the tough opaque white coloured outer covering of posterior five-sixth of the eyeball. Its outer surface is covered by Tenon's capsule and bulbar conjunctiva on its anterior part. Its inner surface is in contact with choroid with suprachoroidal space in between. It is thickest posteriorly and thinnest just behind the insertion of recti. The sclera consists of three ill defined layers, sclera proper with episclera on the outer side and lamina fusca inferiorly. The special regions of sclera are scleral sulcus which houses the Schlemm's canal, scleral spur and lamina cribrosa. The sclera has three sets of apertures:

1. Posterior apertures transmitting long and short ciliary nerves and vessels.
2. Middle apertures through which four vortex veins pass.
3. Anterior apertures transmitting anterior ciliary vessels, perivascular lymphatics and ciliary nerves.

The optic nerve fibres pass through lamina cribrosa of sclera. The avascularity of sclera and lack of reaction of its fibrous tissue to any insult make diseases of the sclera to be relatively rare and when they occur they are chronic and respond slowly to treatment.[2]

Anterior chamber:

The anterior chamber is the space filled with aqueous humour. It is bounded in front by cornea, behind by iris and part of anterior lens surface. Its peripheral recess is called angle of anterior chamber which is bounded by root of iris and ciliary body and anteriorly by corneosclera. Inner to this is Schlemm's canal which drains aqueous humour. At the angle is the trabecular meshwork. The anterior chamber is about 2.5mm deep in the centre.[3]

Iris:

The iris is composed of stroma with a rich blood supply. The anterior surface of stroma is lined by two layers of pigmented epithelium. There are two unstriped muscles, sphincter pupillae and dilator pupillae. Iris is supplied by fibres from trigeminal nerve. The sphincter pupillae is supplied

by oculomotor nerve and dilator pupillae is supplied by fibres from the cervical sympathetic chain.[3]

Ciliary Body:

The ciliary body is composed of ciliary muscle. The inner surface of ciliary body is divide into two areas: the anterior part -pars plicata and posterior part - pars plana. Ciliary processes are seen between the plications which secrete the aqueous humour. The ciliary body extends upto ora serrata.[3]

Choroid:

The choroid is an extremely vascular structure and is separated from the sclera by epichoroidal or suprachoroidal space. The inner surface of the choroid is covered by Bruch's membrane. The choroid is supplied by the choriocapillaries.[3]

Retina :

The retina consists of ten layers which are:

1. Retinal pigment epithelium
2. Layer of rods and cones

3. External limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer
9. Nerve fibre layer
10. Internal limiting membrane

Retina is formed by three strata of cells and their synapses which includes the visual cells externally, bipolar cells intermedially and ganglion cells internally.

Vitreous:

Vitreous humour is a jelly like substance with few cells and wandering leucocytes. It is attached to the posterior surface of lens, vitreous base, the margins of optic disc, macula and blood vessels.

Optic nerve:

Optic nerve consists of about 1.2 million axons of second order neurons. It is divided into:

i. Intraocular part(1 mm)

ii. Intraorbital part(10-16 mm)

iii. Intracanalicular part(5-9 mm)

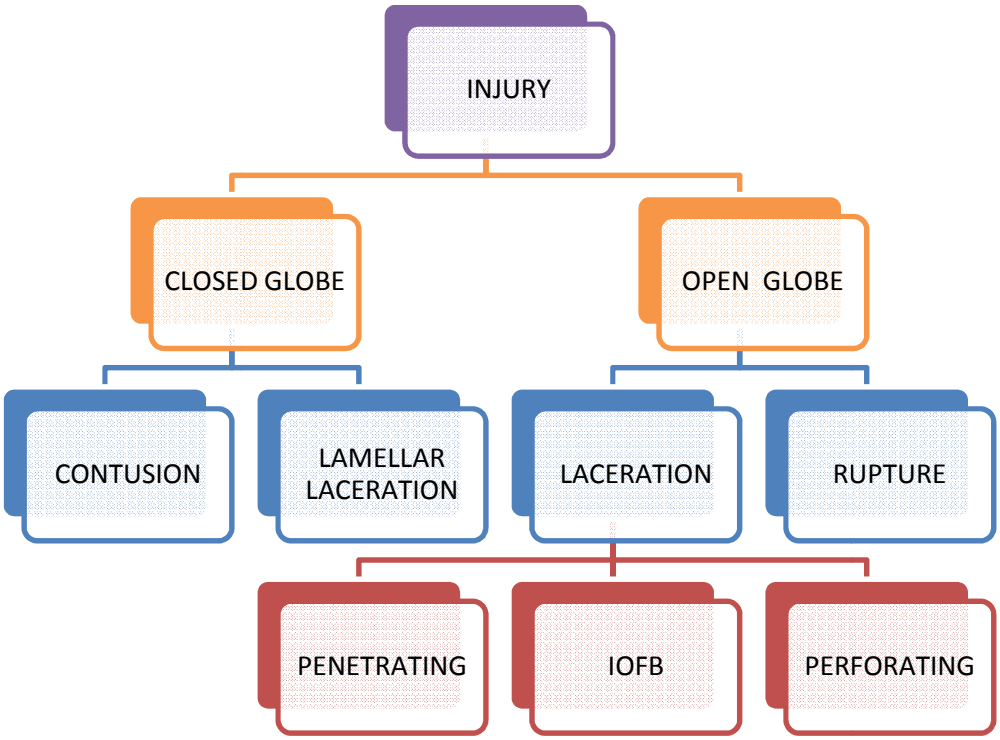
iv. Intracranial part(10-16 mm)

CLASSIFICATION OF EYE INJURIES[4]

Ocular Trauma Classification group has introduced a new classification system based on following variables:

1. Type of injury
2. Grade of injury based on visual acuity at initial examination
3. Presence of relative afferent pupillary defect in involved eye
4. Zone of injury based on location

TYPE OF INJURY



Brimingham eye trauma terminology (BETT):[5]

Eyewall	**:**	Sclera and cornea
Closed globe injury:		No full thickness wound of eyewall
Open globe injury	:	Full thickness wound of eyewall
Contusion	:	No full thickness wound
Lamellar laceration:		Partial thickness wound of eyewall
Rupture	:	Full thickness wound of eyewall caused by blunt object
Laceration	:	Full thickness wound of eyewall caused by a sharp object
Penetrating injury	:	Entrance wound
Perforating injury	:	Entrance and exit wound

GRADE OF INJURY

Grade of injury is based upon visual acuity of the involved eye at the time of presentation.

Grade 1 : greater or equal to 6/12

Grade 2 : 6/18 to 6/36

Grade 3 : 6/60 to 2/60

Grade 4 : no perception of light

PRESENCE OR ABSENCE OF RELATIVE AFFERENT PUPILLARY DEFECT

ZONE OF INJURY BASED ON LOCATION

In open globe injury

Zone 1 : isolated to cornea

Zone 2 : limbus to a point 5mm posterior in to sclera

Zone 3 : posterior to 5mm from limbus[4]

In closed globe injury

Zone 1 : external (limbus to bulbar conjunctiva,sclera and cornea)

Zone 2 : anterior segment (including posterior lens capsule and pars plicata)

Zone 3 : posterior segment (all internal structures posterior to posterior lens capsule)[4]

CAUSATIVE AGENTS FOR EYE INJURIES

The following are the agents which cause potentially dangerous eye injuries:

1. Stick
2. Stone
3. Needle
4. Nail
5. Wooden splinter
6. Shattered glass
7. Pin
8. Chisel
9. Screw driver
10. Sharp metal
11. Finger nail
12. Twig
13. Arrow
14. Thorn
15. Pen and pencil
16. Wire
17. Drill
18. Fish hook

RISK FACTORS

1. Age: Risk due to age has a bimodal curve with first peak between 5-25 years and second peak over 70 years.
2. Gender: In younger ages, the male-female ratio may vary from 1.8:1 to 8:1
3. Socioeconomic status: People of low economic status are at more risk because of the workspace and domestic setting.
4. Type of activity:
    1. At home: Most of the accidents occur at home ie, while doing cooking, household work, gardening etc. Women are prone to develop such injuries in developing countries.
    2. Workplace: The following occupation are more vulnerable to injury Mechanic, blacksmith, electrician, plumber, sand blaster, rock blaster, construction worker, carpenter, military personnel, stone mason, agricultural workers.

       In India where farmers and industry workers form the majority, eye injuries with metallic particles, thorn and stone are very common.
    3. At school and playground: Children are more vulnerable for injury with stick, stone, toys and pencil.

Broomstick injury: This is common among children. The tip of the broomsticks are sharp and highly contaminated. It can cause mechanical damage and infective endophthalmitis.

EVALUATION OF PENETRATING EYE INJURIES

If a patient presents with both ocular and systemic trauma, treatment of life threatening conditions takes priority. Once the patient is found to be systemically stable more detailed history and ocular examination should be carried out. The events preceding and leading to injury, a complete description about the mechanism of injury should be obtained.

Penetrating ocular injury history:

- Visual acuity prior to injury
- Nature of injury
    - Associated life threatening injury
    - Time and circumstance of the injury
    - Suspected IOFB composition(brass, copper, iron, vegetable, glass, soil)
    - Use of any protective eyewear
    - Prior treatment and or evaluation of injury

Past ocular history:

- Ocular diseases
- Refractive history
- Current ophthalmic medication
- Previous surgery

Medical history:

- Diabetes mellitus, immunosuppression, vitamin or protein deficiency
- Medications
- Drug allergy
- Status of tetanus immunization

  The timing of an injury is also important.

Examination

Visual acuity:

Initial visual acuity is the best predictor of final visual acuity. It is essential for prognostic, medicolegal and comparison during recovery time.

External examination: Initial examination should focus on the orbit and periorbital tissues. These areas should be thoroughly inspected and palpated under bright illumination looking for asymmetry, laceration, ecchymoses, edema, lid abnormalities, bone deformities, fractures, exophthalmos, enophthalmos, hypoesthesia, crepitus and foreign bodies.

Ocular motility:

Extraocular motility abnormalities are most likely occur with orbital injuries. Binocular testing of ocular motility should be done. Patients with limited ductions should be further evaluated with forced duction test to differentiate between muscle paresis and entrapment. This test as well as testing with lid retractors is avoided in known or suspected open globe injuries.[5]

Pupillary Examination:

The presence or absence of normal pupillary function is important as a part of ocular examination. Size, shape symmetry, direct and consensual reflex and presence or absence of afferent pupillary defect should be documented.[5]

Anterior segment evaluation:

The eyelids should be evaluated for the presence of laceration. The conjunctival surface is inspected for evidence of laceration and rupture like uveal prolapse or sclera defects. In ocular rupture, a topical anesthetic is applied and the conjunctiva is gently manipulated to look for foreign bodies in the subconjunctival space.

The corneal epithelial defects should be examined for the presence of staining defects, foreign bodies or corneal laceration. Full thickness corneal laceration is followed by swelling of cut edges of the stroma leading to partial or complete sealing of the laceration. Siedel test should be done. This is done by the application of 2% fluorescein to the area of suspected laceration and observed with cobalt blue filter. Aqueous flowing from the laceration and diluting the stain indicates a full thickness wound.

Anterior chamber depth should be examined. An increase in depth is seen in cases of posterior scleral rupture and posterior dislocation or subluxation of lens. Shallow anterior chamber occur in corneal laceration, rupture, vitreous prolapse, choroidal hemorrhage, pupillary block, aqueous

misdirection, anterior dislocation or subluxation of lens. The presence of cells and blood should be noted. In patients with intact globe gonioscopy should be done to look for foreign body at the angle.

The iris should be evaluated for tears in the stroma or sphincter, iritis, iridodialysis and cyclodialysis. In intact globe, gonioscopy should be done to look for angle recession. Iris with transillumination defects may indicate a penetrating injury.

Lens capsule should be inspected for areas of decreased lucency and signs of penetrating injury like cataract, foreign body, or disruption. Lens stability and position should be noted. Pigment dispersion on the anterior lens capsule-vossius ring should be noted. Injury can cause rupture of the zonules resulting in lens subluxation, dislocation or phacodonesis.

The anterior vitreous should be examined for the presence of IOFB and cells which would indicate inflammation.[5]

Posterior segment examination:

In extensive ocular rupture, examination of posterior segment should be deferred until wound is appropriately treated. Slit lamp biomicroscopy and a fundus lens should be used to evaluate the integrity of the posterior pole. Optic nerve head is examined for colour, size of the cup and the presence of edema. The appearance of the macula is noted. The presence of any subretinal hemorrhage may indicate choroidal rupture. Any disruption of retinal perfusion is noted. Any evidence of pigmented debris or cells in the vitreous is to be noted. Presence of cells is an early indicator of traumatic endophthalmitis. Indirect ophthalmoscopy should be done to examine the retinal periphery to look for retinal defects or detachments. A thorough inspection for intraocular foreign body should be done and its location is noted. Tobacco dust in vitreous is suggestive of retinal break. Choroidal rupture if present is noted. They are crescent shaped concentric to the optic disc and can lead to profound visual loss if it occur through fovea.[5]

Intraocular pressure:

It is deferred in eyes with open globe injuries. IOP may be abnormally low in ciliary body dysfunction, occult ocular penetration or rupture. IOP

may be elevated in hyphema, inflammatory debris blocking the trabeculum, foreign body, aqueous misdirection, suprachoroidal hemoorhage or pupillary block from a dislocated lens.[5]

DIAGNOSTIC TESTS

Plain X-ray:

It is a valuable tool for the evaluation of orbital fractures and intraocular or intraorbital foreign bodies. It is cost effective. Disadvantages are it cannot identify & localize radiolucent foreign bodies and fail to show the presence or extension of penetrating orbitocranial injuries.

Ultrasonography:

It is useful in eyes with open globe injuries. It is useful for diagnosing retinal detachment, vitreous hemorrhage, intraocular foreign bodies (both radiolucent and radioopaque), choroidal detachment(can differentiate serous from hemorrhagic), posterior vitreous separation, vitreous incarceration, areas of vitreoretinal adhesion, and presence of any intraocular mass. It is not useful in the evaluation of orbital pathology.

Computed tomography:

It allows detection of exact extension of orbital wall fractures and provides information regarding soft tissue injuries.

Clearly defines soft tissue of orbit, retrorbital space, allows recognition of intraorbital and intraocular air which can occur in penetrating trauma.

Defines exact location of foreign bodies.

It can detect cerebral edema, hematoma and pneumocephalous(signs of intracranial injury)

Contrast enhanced CT is useful in suspected vascular injuries like carotico cavernous fistula and dural arteriovenous malformation.

The disadvantages are:

Thick slice CT may miss very small metallic foreign body.

May fail to detect wooden foreign body.

Magnetic resonance imaging:

It is better in evaluating soft tissues than CT, shows better resolution and detection of any optic nerve laceration or avulsion, can provide better resolution of low density objects like vegetable matter and wooden foreign bodies. Disadvantages are it is more expensive, has longer scanning lines

cannot be used in patients with pacemakers or metallic implants and in suspected metallic foreign bodies and produces motion artifact.[5]

COMPLICATIONS OF PENETRATING OCULAR TRAUMA

ANTERIOR SEGMENT TRAUMA:

Iris :

Can cause direct iris injury as:

1. Iris prolapse
2. Incarceration of iris in the wound
3. Tear in the sphincter and pupillary frill causing irregular non reactive pupil
4. Iridodialysis resulting in acute hyphema.

Traumatic glaucoma:

Acute rise in intraocular pressure may be due to obstruction of trabecular meshwork by red blood cells, platelets, fibrin and inflammatory debris or due to direct damage to outflow system. Large hyphema can cause pupillary block and acute angle closure. Glaucoma can also be caused after several weeks after vitreous hemorrhage due to ghost cells clogging the trabecular meshwork. Late onset glaucoma are due to fibrosis at the angle,

hemosiderosis, formation of peripheral anterior synechiae and posterior synechiae and angle recession.

Zonular injury:

Can cause lens subluxation and dislocation. Diagnosis is done by maximal dilatation to look for separation of zonules from the lens.

Lens injury:

Direct and indirect forces can damage lens epithelium and capsule causing cataract formation. Lens capsule rupture leads to rapid opacification of lens. Lens induced inflammation may occur secondary to release of lens proteins due to traumatic rupture of lens capsule. Phacoanaphylactic uveitis or phacolytic glaucoma may occur after injury to lens. Zonular rupture may allow percolation of vitreous into anterior chamber.

Post traumatic uveitis:

It can occur following direct or indirect penetrating or non penetrating injury. Primary traumatic uveitis is the inflammation secondary to trauma without any underlying disease. Secondary traumatic uveitis is the inflammation associated with or secondary to any systemic disease or

infection worsened by trauma. Penetrating eye injuries can cause bacterial or fungal endophthalmitis.

Intraocular foreign bodies:

They are most common after any activity which has involved striking metal on metal. Foreign bodies can be lodged at the cornea, iris, angle, anterior chamber, lens, vitreous, retina, or orbit.

Foreign bodies can cause infection, chemical reaction and mechanical effect.

Infected perforating wound:

Can occur as a primary infection at the time of injury, as a secondary infection before wound healing or as a later infection resulting in fistula or sloughing.

Sympathetic ophthalmia:

It results from penetrating injury involving ciliary body and its incarceration. Incarceration of iris or lens capsule also can cause sympathetic ophthalmia.

Post traumatic astigmatism is a common sequelae following corneal injury.

An occult scleral rupture may occur. Chemosis or subconjunctival hemorrhage suggests presence of occult rupture.

MANAGEMENT:

CORNEOSCLERAL WOUNDS:

Broad spectrum systemic antibiotics should be started immediately.

Self sealing corneal corneal wounds (3-4mm) without retained foreign bodies with maintenance of anterior chamber can be conservatively managed with antibiotic drops or ointment, cycloplegics and therapeutic contact lens.

Wounds with spontaneous leakage or flat anterior chamber may be managed with cyanoacrylate glue after filling the anterior chamber with viscoelastic material. After reconstruction of anterior chamber, the wound is dried and the glue is applied with a needle or sterile brush. It is necessary to wait for 7-12 minutes for the glue to dry completely. Then the viscoelastic

material is removed from the anterior chamber and a therapeutic contact lens is applied to avoid irritation of the tarsal conjunctiva and to prevent removal of the glue.[6]

Corneal wounds – surgical approach:

The aims of surgical approach are

1. To restore globe integrity.
2. To restore anatomy of the eye
3. To avoid future complications

Any remnants of tissue preventing apposition of wound borders should be removed. Uveal tissues should be replaced and the necrotic parts are removed. As a rule those tissue that have been exposed for less than 24-36 hours can be replaced, those exposed for longer duration, showing colour changes or necrosis should be removed.[6]

Corneal suturing:

Corneal sutures are essential in children, large laceration, displaced wounds, wounds with loss of tissue and laceration with incarceration of tissue.

Unsutured corneal incision flatten cornea whereas sutured incision both radial and circumferential flatten cornea under the suture but steepens it closer to visual axis or corneal centre.

The principles to be followed during corneal suturing are:

Zone of tissue compression along the incision is approximately equal to the length of the suture. The zones of compression caused by adjacent suture are to be in contact or overlap slightly to avoid wound leakage.

The sutures should be equidistant and parallel to each other.

The depth of the sutures depend on the amount of tissue lost. The suture needle passes through the entrance and exit points are made of 90% depth for correct apposition. In oblique wounds the intrastromal length should be equal to avoid overriding.

Corneal laceration should be sutured from periphery to centre, first stabilizing the limbus. As the corneal centre approaches suture should be shorter with sufficient tension and length to allow border confrontation and to avoid formation of fish mouth openings, which can cause aqueous leakage.

Monofilament 10-0 nylon suture material is preferred because it causes least astigmatism.

Full thickness bites are usually avoided because the can introduce microbes from the ocular surface. The anterior chamber is then deepened and the wound is checked for leakage. All knots are timed and buried superficially away from the visual axis for minimal scarring, inflammation and neovascularisation.

In cases of stellate corneal laceration, multiple interrupted, bridging or purse string sutures are useful.

A peritomy near the damaged area should be performed when both cornea and sclera are involved to improve wound visibility. Then wound is sutured from the more distal end and continued anteriorly. Once the wound is closed, peritomy may be enlarged for the exploration of more posterior areas. The orbital tissues might seal them.

Globe reconstruction may not be a better option when corneoscleral wounds are wide with loss of large amount of intraocular contents. Enucleation can be done in such cases also to prevent sympathetic ophthalmia.[6]

Corneal laceration with involvement of lens:

The indications for primary lens removal with corneal tear repair are:

1. Disrupted capsule and lens material in anterior chamber.
2. Cataractous lens
3. Admixture of lens remnants and vitreous

A separate limbal incision is made for extraction of the lens and should never be done through the wound. If the zonules and posterior capsule are intact, standard ECCE can be done. Intraocular lens implantation can be of individual choice.[7]

Corneal laceration with involvement of vitreous:

The primary goal in such cases is to release any vitreous incarceration to prevent chronic inflammation, cystoid macular edema, vitreous fibrosis, retinal detachment, infection due to vitreous wick syndrome and corneal endothelial damage due to vitreous touch.[6]

Traumatic hyphema:

It is important to exclude systemic disorders like sickle cell anemia and hemophilia. Steroids should be started to control inflammation. If IOP is high, it is controlled initially using beta blockers and acetazolamide if there are no contraindications. Surgical intervention is done when there is blood staining of cornea, if the intraocular pressure is greater than 60mm of Hg, if there is eight-ball hemorrhage or if the IOP is above 35mm of Hg for seven days.[8]

Traumatic glaucoma:

Topical steroids are used in minimal inflammation. They reduce the formation of anterior and posterior synechiae. Acute rise in IOP is treated with beta blockers, alpha agonists and carbonic anhydrase inhibitors. In pupillary block, laser peripheral iridotomy should be done. Any factors leading to glaucoma are to be treated. Chronic glaucoma is treated with medical therapy. Laser trabeculoplasty can be done. Filtering surgery should be done if the above measures fail.

Intraocular foreign body:

Management of an intraocular foreign body injury require immediate closure of the globe and removal of the IOFB. The patient should be started on broad spectrum antibiotics. Tetanus prophylaxis is necessary.

The appropriate technique for IOFB extraction depends on the location, composition, size, shape number of IOFB, and associated ocular abnormalities. Foreign bodies at the angle, iris, anterior chamber or lens can be extracted through a limbal incision placed over the object or across anterior chamber.

Magnets are commonly employed for the majority of magnetic IOFB. Their ability to automatically align the IOFB in the long axis of the magnetic field and deliver the smallest diameter through the sclerotomy makes them ideal. Magnetic intraretinal or subretinal IOFB located anterior to equator may be removed through a scleral cut down. IOFB localization is done using indirect ophthalmoscopy and diathermy should be applied to the uveal bed prior to IOFB delivery to limit hemorrhage during transuveal passage. Surrounding laser photocoagulation is applied if the foreign body is intraretinal prior to its removal. After removal a scleral buckle may be placed if necessary.

Visible magnetic foreign body in the vitreous or on retinal surface should be removed with an external magnet through a pars plana incision.

Posterior segment IOFB that are obscured by opaque media, composed of non magnetic material or embedded in the posterior retina, choroid or sclera may require a pars plana vitrectomy.[9,10,11,12,13,14]

Posterior segment complication:

Penetrating eye injury can cause retinal breaks which are mostly seen along the anterior or posterior border of vitreous base. Non rhegmatogenous retinal detachment can occur due to traction to the retina from dense vitreous membranes that are formed after injury. Penetrating eye injury can cause proliferative vitreoretinopathy.

Penetrating injury with vitreous loss:

Vitreous incarceration is common and detachment occurs. Traction is exerted by vitreous gel at its area of attachment. Retinal detachment is caused by retinal tear located far from penetration site.[15]

Traumatic endophthalmitis:

This occurs in 2-7%of all penetrating ocular injury. Injuries along with foreign bodies contaminated by soil or vegetable matter are at increased risk in developing endophthalmitis. The organisms commonly causing endophthalmitis are staphylococcus, streptococcus and bacillus species. The risk factors are surgical primary repair after 24 hours following injury,

delayed antibiotic therapy, presence of intraocular foreign body, injury to lens and wound length of more than 5mm.[16,17,18,19,20]

Optic nerve involvement:

There can be partial or complete transection of optic nerve following penetrating trauma or by the intruding object.

Management of posterior segment complication:

Posterior segment evaluation would be difficult due to the presence of traumatic cataract in most of the cases. IOP should be checked digitally. If IOP is low, then retinal detachment should be suspected.

The primary aim of surgery is to prevent secondary complications like retinal detachment, endophthalmitis, cyclitic membrane and damage caused by retained foreign body.

Posterior segment repair is divided into primary and secondary repair.

Primary repair is immediate action to restore external anatomic globe integrity.

Secondary repair is taken to restore intraocular anatomical globe integrity like:

Cataract extraction

Vitrectomy

Removal of intraocular foreign body

Drainage of hemorrhagic choroidal detachment

Intravitreal antibiotic injection

Scleral buckling

Indications for vitrectomy following penetrating ocular trauma:

1. Vitreous incarceration into wound
2. Vitreous hemorrhage with retinal detachment
3. Vitreous hemorrhage with retinal tear
4. Retained foreign body
5. Vitreous hemorrhage with posterior lens capsular rupture
6. Retinal detachment
7. Posterior scleral perforation
8. Vitreous hemorrhage with ciliary body laceration

Vitrectomy is done to remove the injured vitreous gel completely. It can be done: early (within 72 hours) , late(3-14 days) or delayed(>3 weeks).

Indications for early vitrectomy are:

1. Endophthalmitis
2. Intraocular foreign body contaminated with soil
3. Retinal detachment
4. Non magnetic and copper containing foreign body
5. Reactive foreign body

Indications for late vitrectomy (3-14 days):

1. Lens vitreous injury
2. Severe vitreous hemorrhage
3. Retinal detachment
4. Intraocular foreign body
5. Double perforating wound

Indications for delayed vitrectomy (>3 weeks):

1. Epiretinal membrane formation
2. Vitreous opacification
3. Ghost cell glaucoma
4. Dislocated lens
5. Retinal detachment with proliferative vitreoretinopathy

Sequelae following primary wound repair are:

1. Corneal scarring, fibrovascular pannus and astigmatism
2. Pupillary or cyclitic membrane
3. Secondary glaucoma
4. Conjunctival scarring and symblepharon
5. Vitreous incarceration into the wound and associated inflammation, cystoid macular edema, retinal detachment and infection.

Techniques of secondary reconstruction are:

- Penetrating keratoplasty
- Lens removal
- Anterior vitrectomy
- Removal of organized fibrovascular and hyaloid membrane
- Goniosynechiolysis
- Iridoplasty

Lid injury:

Penetrating eye injury can be associated with injury to lid and canthus. The injured eyelid tissue should be handled with delicate instruments and precision. After cleaning the tissues, the laceration should be placed in its anatomical location. Simple laceration involving only the skin and orbicularis is sutured with small caliber sutures. When lacerations run across normal skin tension lines, a vertical mattress suture may be placed. Full thickness eyelid lacerations should be repaired so that lid margin is restored.

VISUAL PROGNOSIS OF PENETRATING OCULAR INJURY

Depends on the following factors:

1. **Initial visual acuity:**

   Visual acuity at the time of presentation is the most important factor in predicting final visual acuity.

2. **Afferent pupillary defect:**

   This indicates optic nerve or retinal dysfunction and is usually associated with poor visual outcome.

3. **Size of laceration:**

   Corneal laceration >9mm carries poor prognosis.

4. **Location :**

   Posterior segment injuries involving vitreous, retina, ciliary body and those causing vitreous hemorrhage carry poor prognosis.

5. **Site :**

   Lacerations along the visual axis carries poor prognosis.

6. **Endophthalmitis:**

   Traumatic endophthalmitis carries a poor prognosis though prompt effective treatment is initiated due to delay in diagnosis.

7. **Hyphema:**

   Nearly 75% of eyes with hyphema have a visual outcome of 20/50 or better but in cases with half to near total hyphema and total eight ball hyphema only 25% to 50% regain vision better than 20/50.

8. **Presence of intraocular foreign body:**

   Large foreign bodies have poor prognosis. Because of the newer techniques it is achieving a better prognosis now.

PREVENTION OF EYE INJURIES:

Health promotion includes health protection, health education and prevention of diseases. Vision is a powerful determinant of health and well being. So its preservation is a health promoting activity. Eye health promotion stresses the responsibility of the society both at the government and at community level in the maintenance of eye health.

Preventive measures:

1. Protective wears made of polycarbonate lens are usually preferred. They are particularly needed for:
    a. One eyed patients
    b. Persons with thin retina, weak sclera, bleeding tendencies
    c. Work activities with risk of ocular injury
    d. Sports activities with risk of ocular injury
2. Static shielding equipments- established safety barriers when high speed grinders, cutters are being used.
3. Hazardous toys should not be given to children.
4. Glasses and sharp metals should be out of reach of children.
5. Stick and tools used in garden should be handled properly.
6. Defective machinery are to be corrected.
7. Children should be supervised.
8. Children should be taught regarding the dangers of pen, pencil, scissors, etc.

Prevention is the core of eye injury management.

REVIEW OF LITERATURE

1. David et al had reported that 80% of the penetrating eye injuries occurred in males and the mean age was 29 years. The most common initial physical findings in his study included hyphema (76%), abnormality of pupil and uvea (94%). The initial visual acuity was worse than 20/200 in 77% of the patients. Complications occurred in about 25% of the cases, most commonly traumatic cataract and infection. Final visual outcome was 28% with enucleation, no perception of light in 10% of the patients, light perception to 20/200 in 24%, 20/200 or better in 36% of the patients. Complications were present in 25% of the cases, majority were traumatic cataract or infection.[21]

2. Hany E El Mekawey et al reported that open globe injuries were the most prevalent comprising 33.45% of the emergencies. Most patients were male (69%). The age group 6-16 years accounted for 24% of the injuries and patients over 45 years accounted for 26.8%. The most common ocular hemorrhage was hyphema. The most common type of glaucoma was acute angle closure. Violent activities(41.9%),

occupational injuries(26.3%) and motor accidents(24.4%) were the main causes resulting open globe injuries in the region of upper Egypt.[22]

3. Thompson et al reported that the most common cause of penetrating ocular injury was fencing wire in the region of rural South Wales (18.2%) then followed by hammering metal (16.9%). The mean age was 32.6 years. 88% of them were males. The commonest location of injury was at home accounting for 38%. The location of the injury was corneal in 57%, sclera in 19% and corneoscleral in 23% of the patients. Final visual acuity of 6/12 or more was attained in 61% of the patients. Visual prognosis was best for injuries which involved the cornea only.[23]

4. Patel et al reported that of the total penetrating ocular injuries 34% were involved in children below the age of 15 years. Dart, knife and airgun injuries constituted 41% of the trauma. Of them 54% attained a visual acuity of 6/12 or better. 12% had undergone enucleation. From the analysis of activities that caused injury it was considered that most of the injuries could be prevented.[24]

5. Caroline et al reported that 69.9% of the penetrating eye injuries occurred during work, 18.3% while leisure and domestic activities, 2.3% occurred during sports activities, 1.9% of the injuries due to assaults, 2.3% of them due to contact lens injury and in 5.3% of the patients the cause was not known. Children below 10 years constituted 4%. In 98.3% of the individuals periorbital and superficial ocular structures were involved. The intraocular structures were involved in remaining cases. Only one case of intraocular foreign body was present. 36.3% of the patients underwent surgery. Most of the injuries did not threaten sight in the adult population. But injuries in children were sight threatening.[25]

6. Fasina et al reported that 58% of the injuries occurred at home in a domestic setting. The commonest mode of injury was projectile missiles. 80% of the patients were males and male to female ratio was 4:1.The mean age affected was 18 years.41.5% of them were below 15 years of age. The right eye was involved in 45.9% of the patients. The commonest agent of injury was metallic piece or vegetative matter. Most of the injuries involved the cornea accounting to 43.7%,

corneoscleral injury was present in 41.5%, 68.1% of them had uveal prolapse, hyphema was present in 47.4% and 28.1% had cataract. [1]

7. Gyasi et al reported that males constituted 75% of the injured patients. Patients below 30 years accounted for 82.3%. Right eye was affected in 44.8% of the patients. Visual impairment at the initial presentation was present in 89.5% of the patients. At the time of discharge, 69.3% of the patients had visual impairment.[26]

8. Usha et al reported that 33.33% of the open globe injuries were related to occupation. Among the patients 95.35% were males and females constituted 4.65%. Patients in the age group between 16 to 45 years accounted for 79.06%. 37.5% of the injuries were caused by sickle and stick. 12.5% of the injury was due to bullgore injury. 63.7% of the patients were injured while working on lathe machine. 36.84% were injured due to grinding machine. 68.42% of the injured patients were not wearing protective eye wear. 55.81% required primary wound repair, lens extraction was done in 23.26% of the patients. Primary evisceration was done in 13.95% and intravitreal antibiotics

were administered in 6.97% of the patients. Extracapsular cataract extraction with PCIOL implantation was done as a secondary procedure in 27.91% of the patients.[27]

9. Malla et al reported in his study that males were commonly involved accounting for 71.9% and females accounted for 28.1%. majority of the injuries occurred at home. Students constituted 32.8%, farmers were 17.2%, labourers were 14.1% and housewives were 3% among injured. The commonest agent of injury was mechanical objects like wooden particles, metallic pieces and stone constituting 84.3%. Agricultural agents accounted upto 11.7%. 52.4% of the patients had hyphema.[28]

10. Mukherjee et al reported that males were more commonly affected accounting for 73.17%. Patients below 30 years accounted for 44.91%. Metallic injuries were the most common form of injury accounting for 33% which reflected the increased incidence of industrial accidents. Corneal perforation was present in 62.21% of the patients, 29.26% of the patients had corneoscleral injury and scleral

injury was present in 8.53% of the patients. Lens was involved in 56.10% of the patients and hyphema was present in 39.02% of the patients. Posterior segment involvement was present in 34.14% of the patients.[29]

11. Wykes et al reported that penetrating eye injuries were more common among the male population with a ratio of 7:1. In 48% of the patients right eye was involved and in 52% of the patients left eye was injured. Sports and play injury was the most common (79.2%) among children. Among the adults, 53% were due to industrial accidents. Final visual acuity of 6/12 and more was attained in 43.3% of the patients.[30]

12. Michael et al reported that majority of the patients with penetrating eye injury were in the age group 21 to 30 years. Males were more affected than females. Majority of the patients were injured in domestic settings. Traumatic cataract and corneal perforation were the commonest manifestations. 47.6% of the patients attained a final visual acuity of 6/6 to 6/12.[31]

13. Barry et al reported in a survey conducted on ocular trauma that 36.3% of the ocular trauma is constituted by penetrating corneal injury. He also reported that intraocular foreign bodies were associated with 73% of the penetrating injuries.[32]

14. Jazy et al reported that occupational injuries accounted upto 15.6%. the mean age was 33.8 years. Majority of the injured were males. 35.7% of the injuries were due to repair and maintenance work. Corneal injury accounted to 57.1%, 28.6% were scleral, 14.3% were corneoscleral. 28.6% of the injuries were associated with intraocular foreign body. 25% of the patients showed improvement in final visual acuity, 50% did not improve after treatment.[33]

AIMS AND OBJECTIVES

The following were the aims and objectives of this prospective study:

1. To determine the risk factors associated with penetrating eye injuries.
2. To study the different causative agents and to analyse the visual outcome following penetrating eye injuries.

MATERIALS AND METHODS

This is prospective study of 52 patients with penetrating eye injury admitted at government Rajaji Hospital, Madurai from March -2012 to November – 2012. A total of 60 patients were enrolled but 8 of them were excluded from the study because of poor follow up.

All patients who presented with penetrating eye injuries were selected for this study. Various patients were enrolled and categorized according to many criteria like age, sex, place at which the injury occurred and causative factors.

All patients were examined and been followed up for a minimum of three months.

INCLUSION CRITERIA:

1. Patients with history of injury having slit lamp evidence with or without the presence of foreign body.
2. All age group
3. Minimum follow up period of 3 months.

EXCLUSION CRITERIA:

1. Poor follow up of less than 3 months.
2. Pre existing corneal pathology like previous scar, prior ocular trauma and keratoconus.

The following parameters were noted for all the patients:

1. Name, age, sex of the patient
2. Occupation and the place at which injury occurred
3. Agents involved in causing injury
4. Any prior treatment and the time elapsed since trauma
5. Visual acuity with pinhole at presentation
6. Slit lamp examination to evaluate the extent of injury.
7. Investigations like plain X-ray in suspected metallic foreign body. Ultrasonogram was done in all cases to evaluate the posterior segment, to see the integrity of the posterior capsule and to see the presence of any foreign body. CT scan was also done to find out the exact location of foreign bodies and in the case of associated fractures.
8. Treatment: Informed consent was taken from all patients. The patients were started on broad spectrum antibiotics. Further treatment was done based on whether the wound was self-sealing or not. In self sealing injury with normal anterior chamber without any uveal prolapse, medical line of management was done. Except for pediatric cases where the wound was sutured. In the case of leaking wounds,

primary repair of the wound along with abscission of prolapsed uveal tissue and anterior chamber reformation was done. In cases of traumatic cataract, cataract extraction and IOL implantation was done as a secondary procedure in most of the cases. Vitrectomy was done in a case with intraocular foreign body.The treatment given, medical or surgical was analyzed.

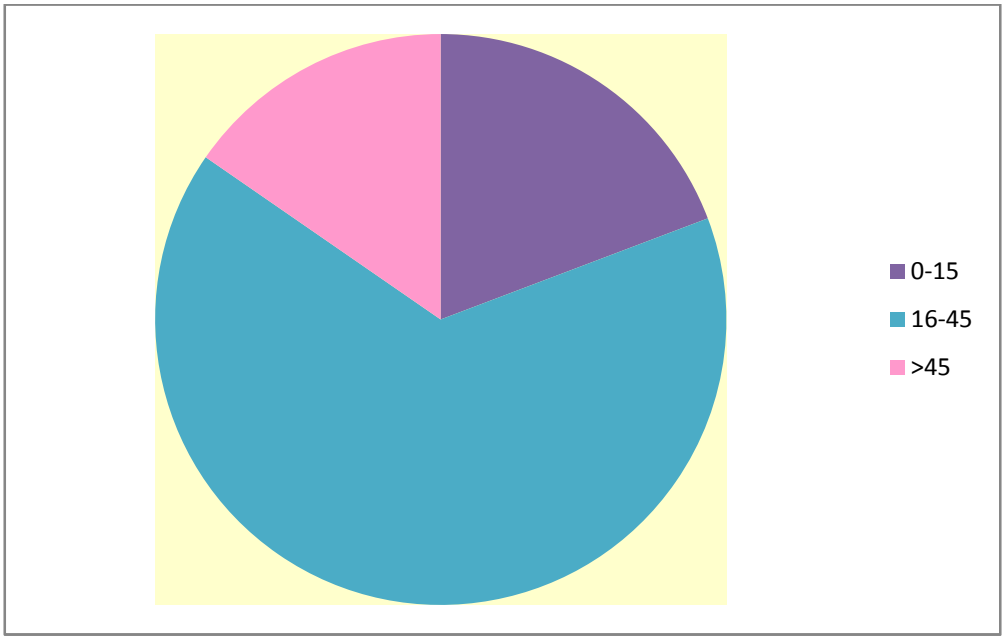
9. Final best corrected visual acuity was recorded at the end of three months.

OBSERVATION AND RESULTS

1. Age pattern

Age group	Frequency	Percent (%)
<15 years	10	19.2
16-45 years	34	65.3
>45 years	8	15.3

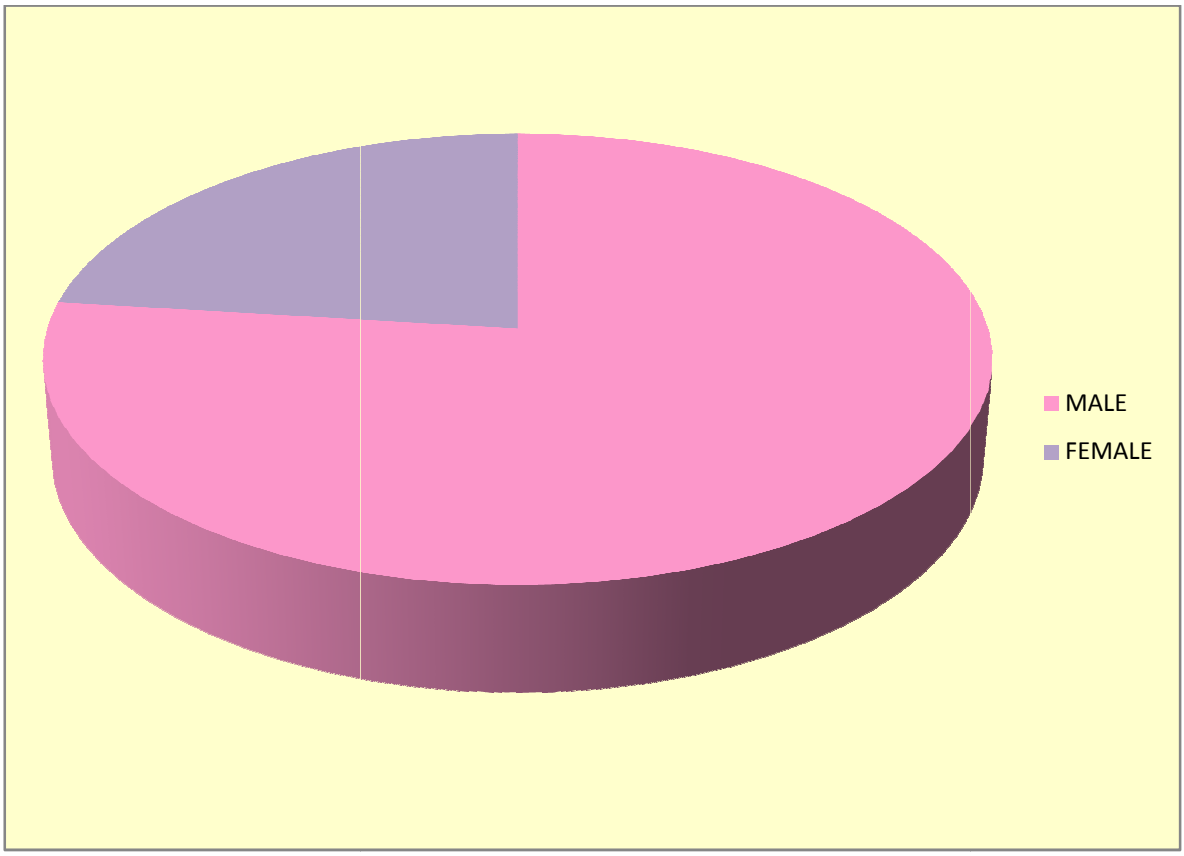
All age group were included in this study. The minimum age was 6 years and maximum age was 70 years. Majority of the patients were in the age group of 16-45 years accounting for 65.3% followed by patients less than 15 years.



2. Gender

	Frequency	Percent (%)
Male	40	76.9
Female	12	23.1

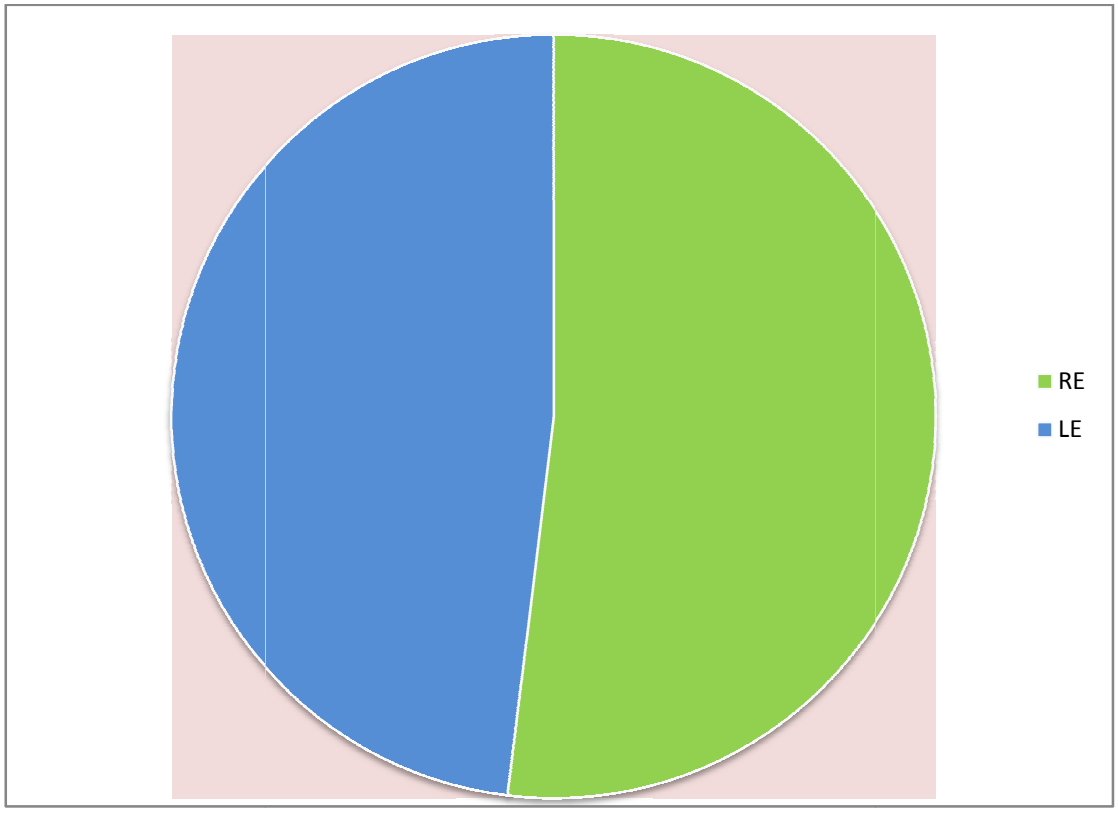
Most of the patients were male (76.9%). Male: female ratio was 3.3: 1



3. Laterality

	Frequency	Percent (%)
RE	27	51.9
LE	25	48.1

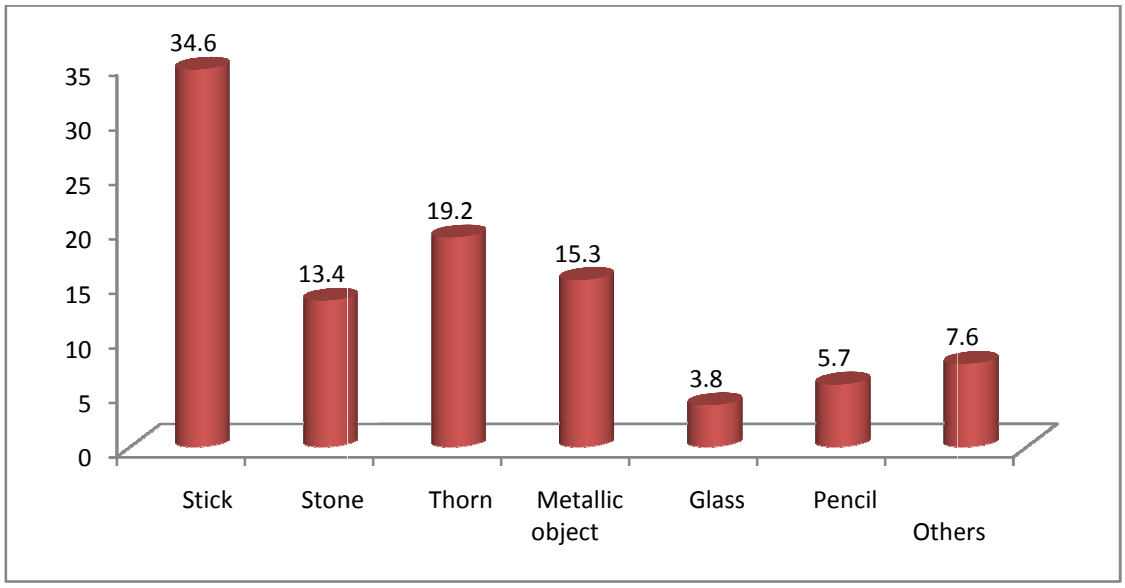
All the patients had unilateral injury. There was no significant preponderance.



4. Agent involved

Agent	Frequency	Percent (%)
Stick	18	34.6
Stone	7	13.4
Thorn	10	19.2
Metallic object	8	15.3
Glass	2	3.8
Pencil	3	5.7
Others	4	7.6

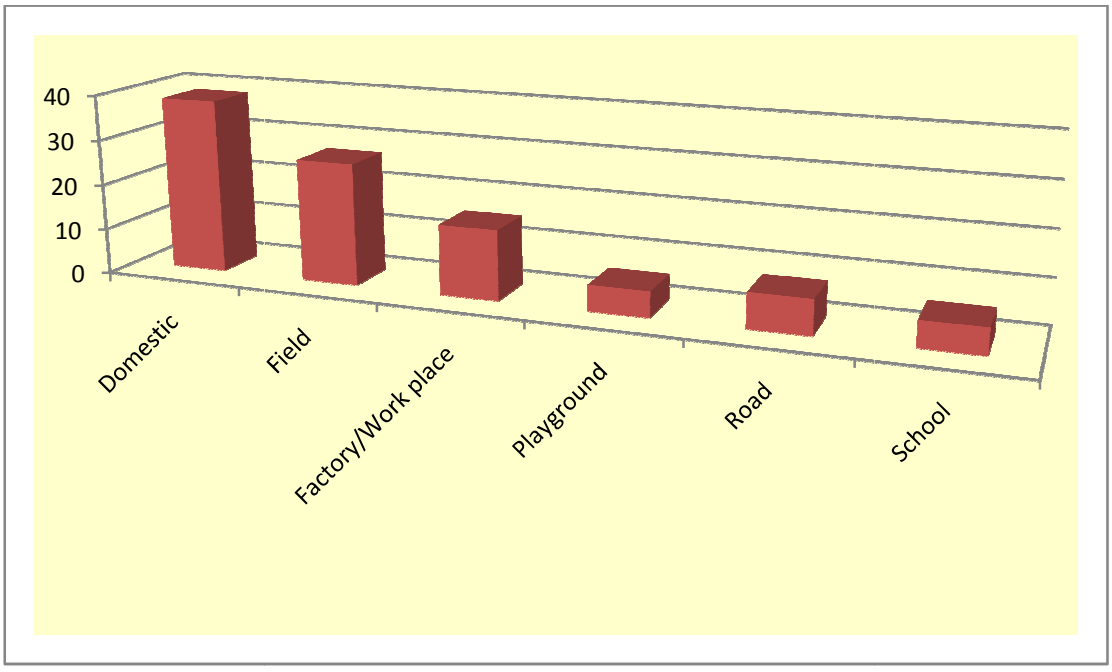
The commonest agent of injury was stick (34.3%) followed by thorn (19.2%).



5. Place of injury

	Frequency	Percent (%)
Domestic	20	38.4
Field	14	26.9
Factory/Work place	8	15.4
Playground	3	5.7
Road	4	7.7
School	3	5.7

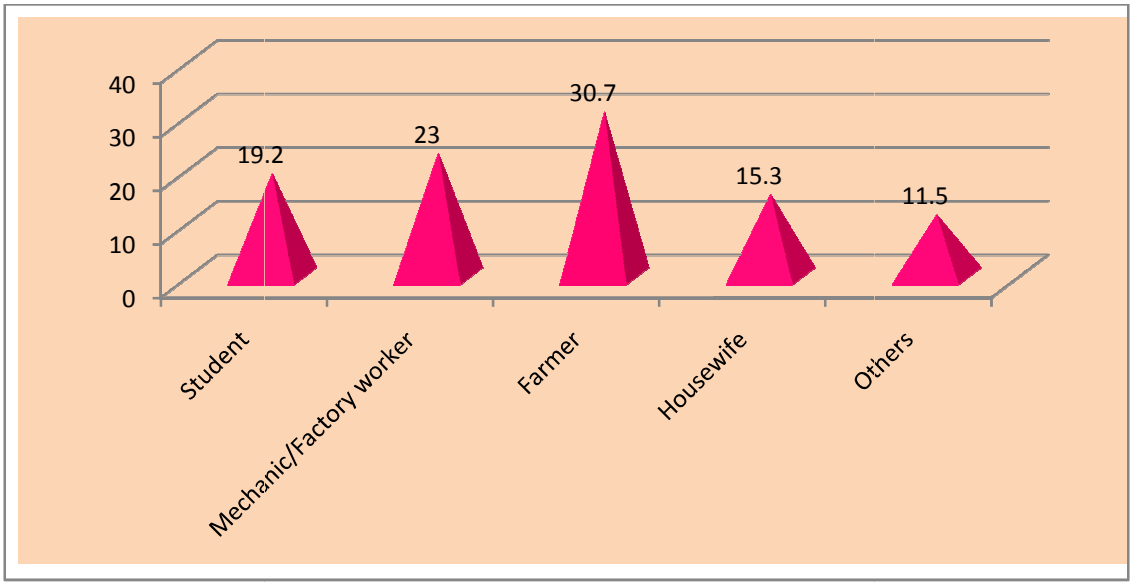
Most of the injury was at home (38.4%) followed by field (26.9%).



6. Occupation

	Frequency	Percent (%)
Student	10	19.2
Mechanic/Factory worker	12	23.0
Farmer	16	30.7
Housewife	8	15.3
Others	6	11.5

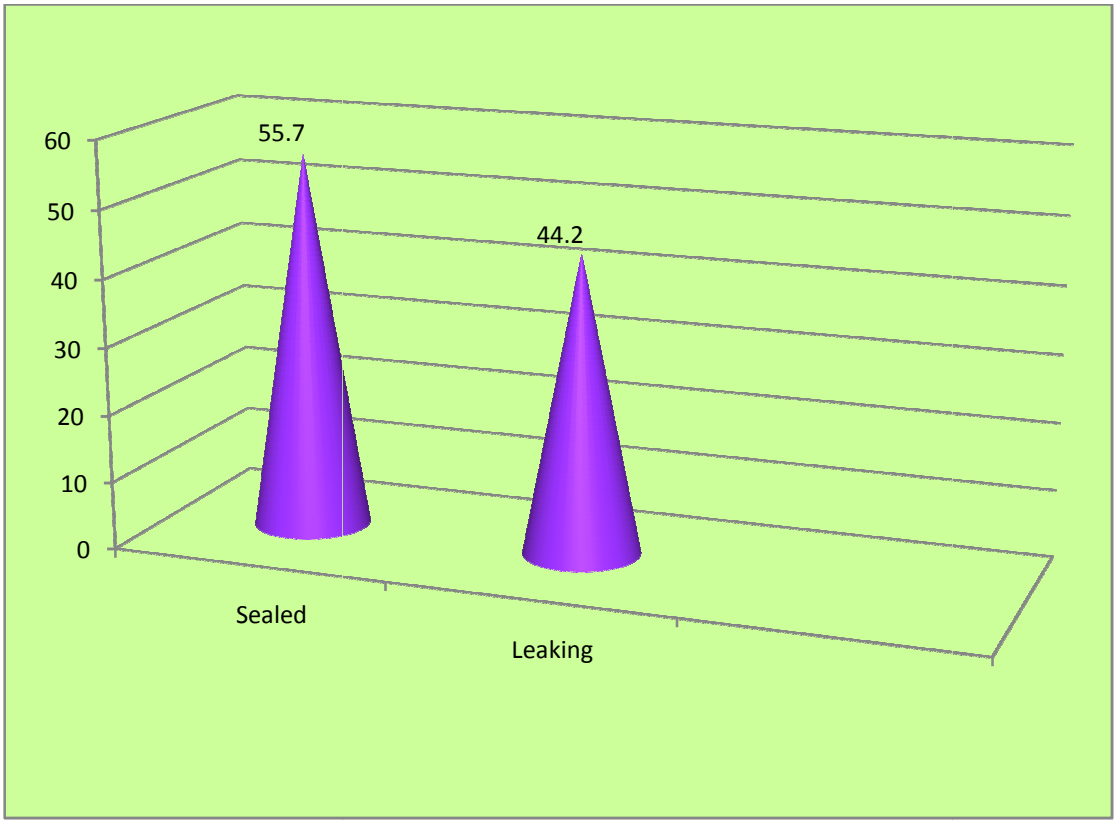
30.7% of the patients were farmers. This could be attributed to the fact that most of the people visiting here are from rural areas whose occupation is agriculture.



7. Corneal perforation

	Frequency	Percent
Sealed	29	55.7
Leaking	23	44.2

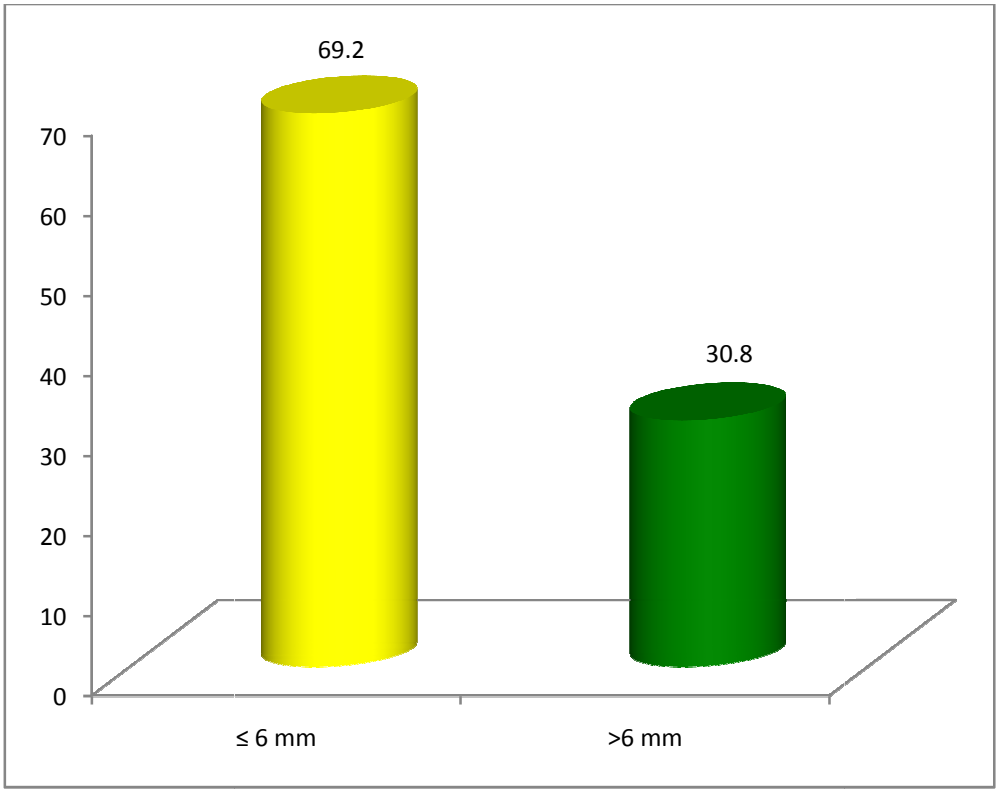
Most of the cases had self sealed corneal injury(55.7%).



8. Corneal wound size

	Frequency	Percent (%)
≤ 6 mm	36	69.2
>6 mm	16	30.8

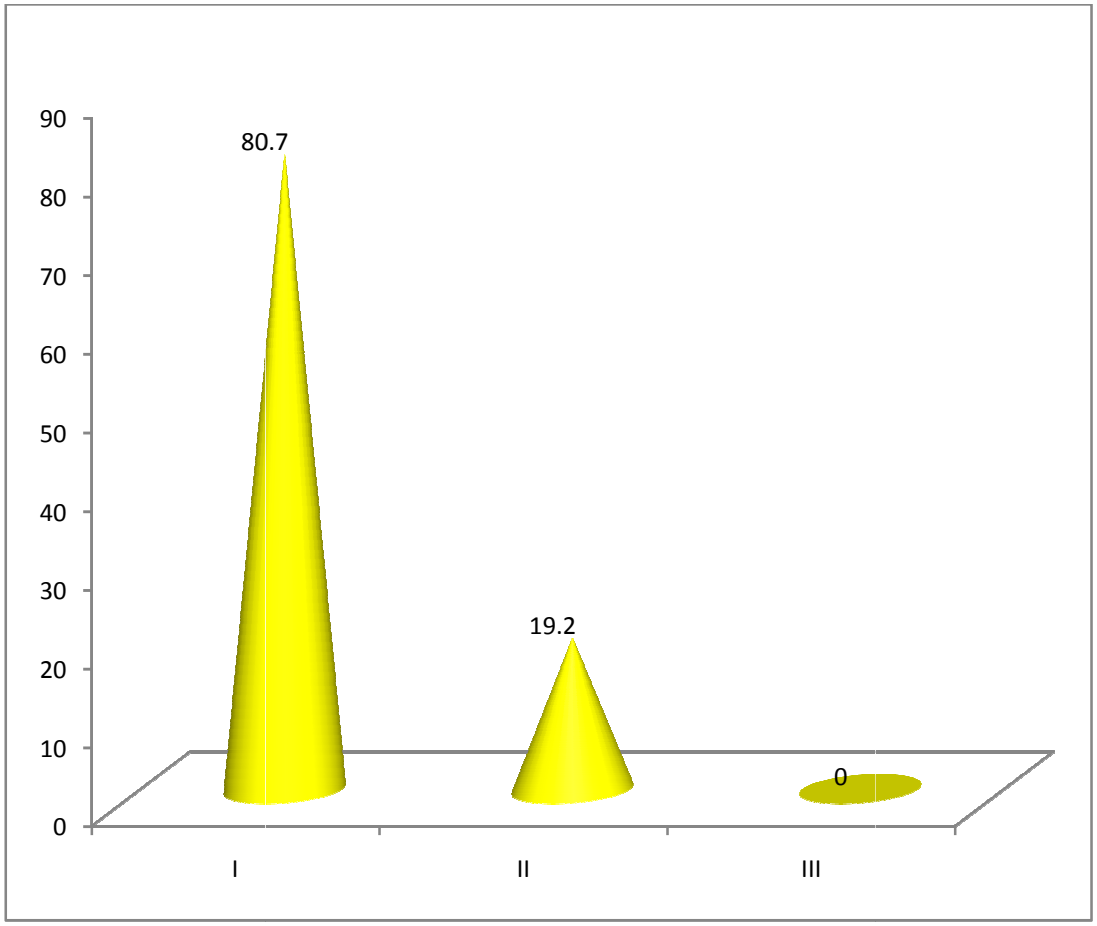
69.2% of the injuries were less than or equal to 6 mm.



9. Zone of injury

	Frequency	Percent (%)
I	42	80.7
II	10	19.2
III	-	-

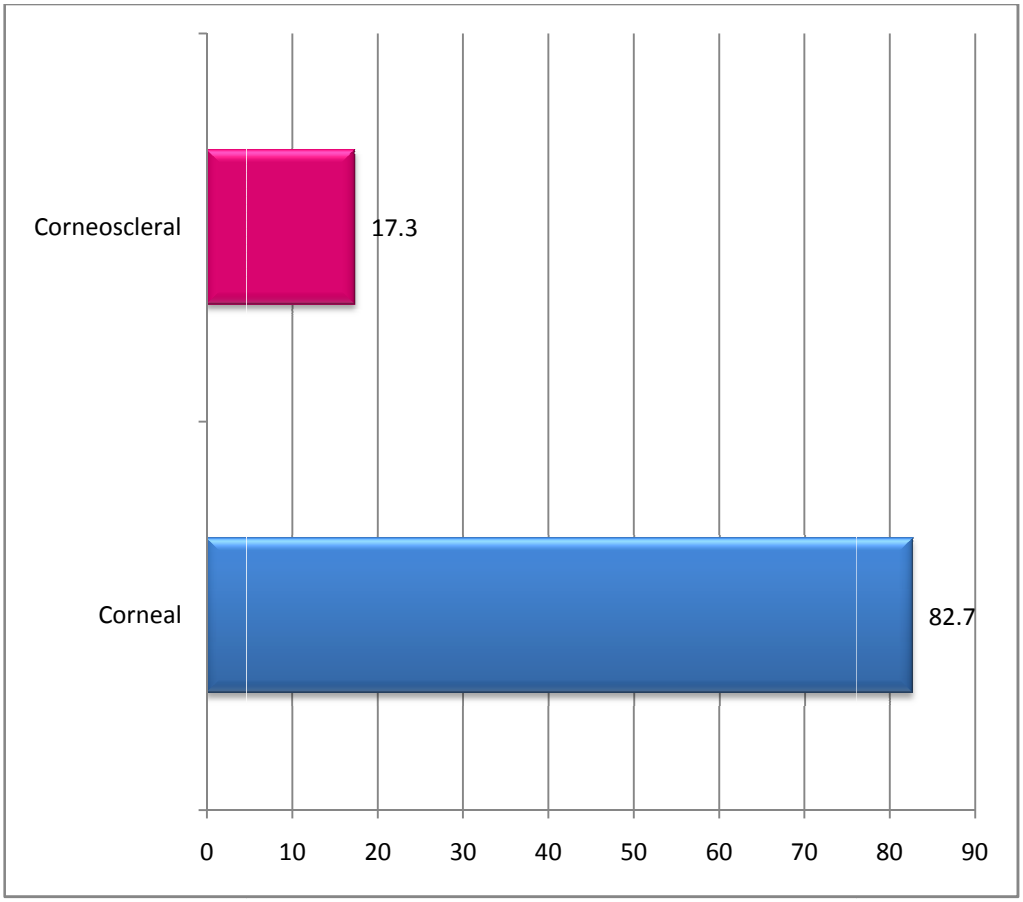
80.7% of the injuries were in zone I



10.Wound site

	Frequency	Percent (%)
Corneal	43	82.7
Corneoscleral	9	17.3

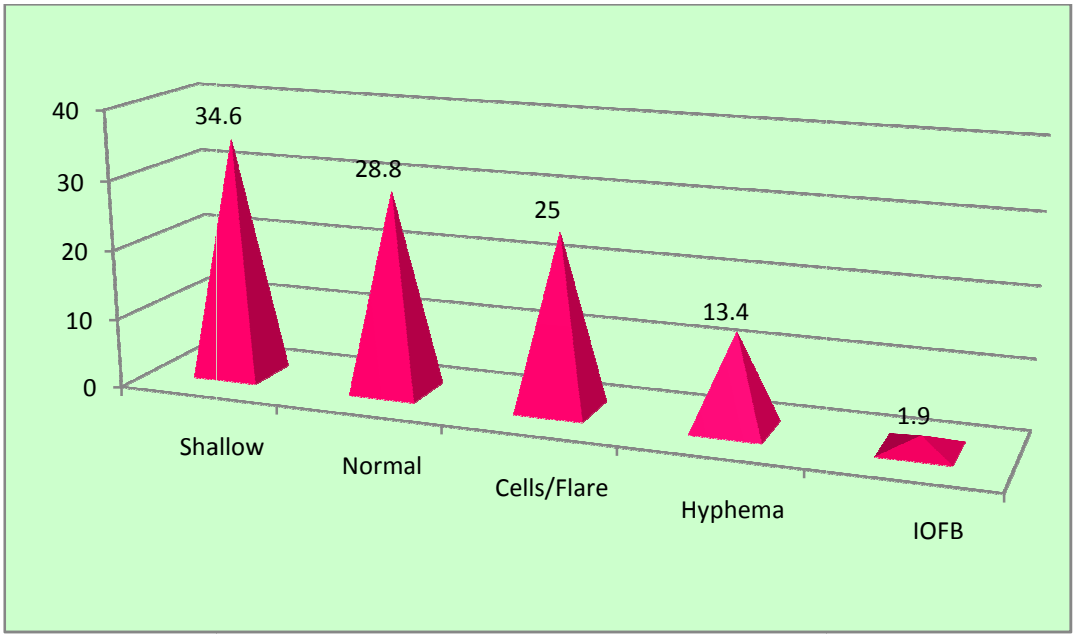
Majority of the injury involved the cornea (82.7%)



11.Anterior chamber

	Frequency	Percent (%)
Shallow	18	34.6
Normal	15	28.8
Cells/Flare	13	25.0
Hyphema	7	13.4
IOFB	1	1.9

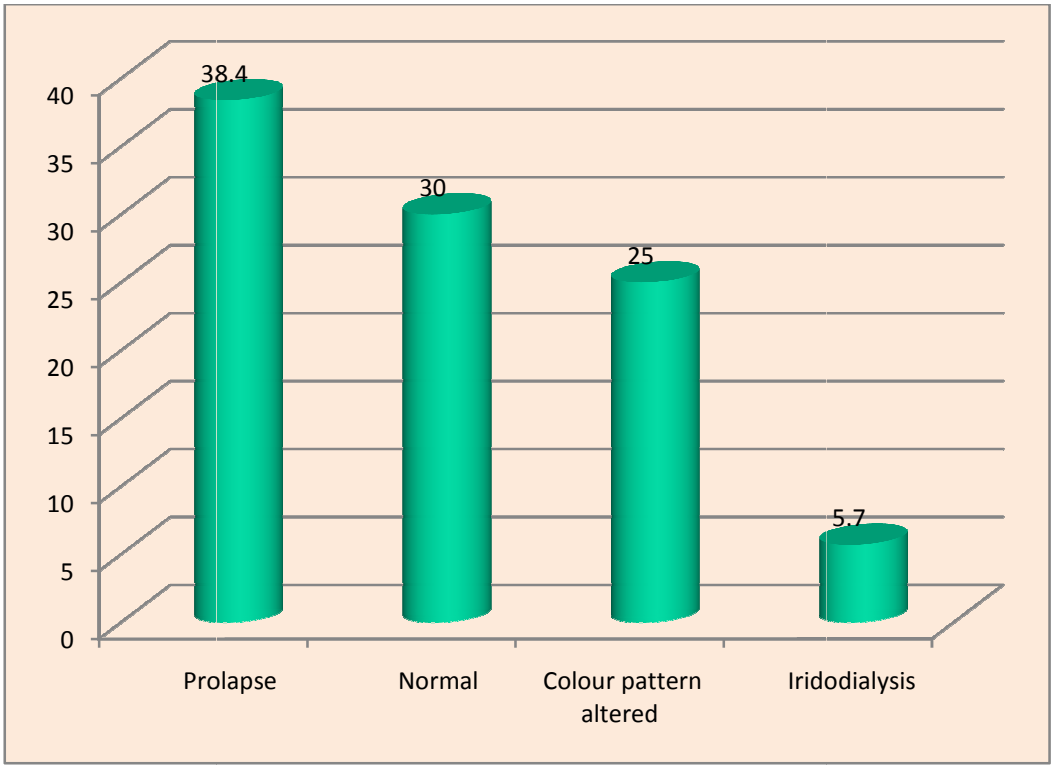
Majority of the wounds had shallow anterior chamber (34.6%). Anterior chamber was normal in 28.8% of the patients. There was a foreign body in the anterior chamber of 1 patient.



12.Iris

	Frequency	Percent (%)
Prolapse	20	38.4
Normal	16	30.0
Colour pattern altered	13	25.0
Iridodialysis	3	5.7

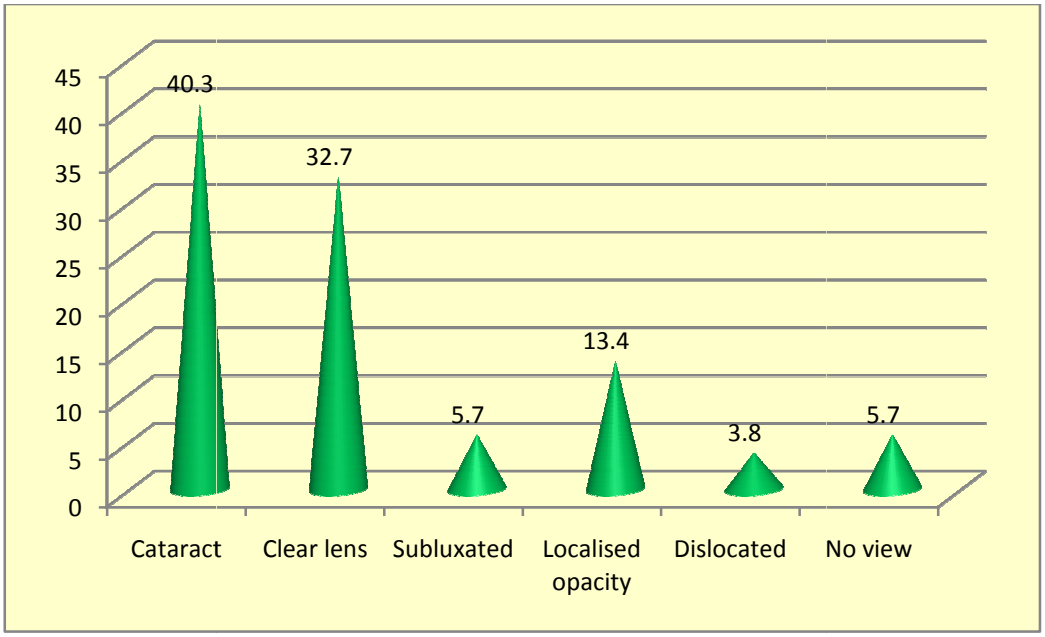
Most common form of uveal involvement was iris prolapsed (38.4%). Iris was unaffected in 30.0%



13.Lens changes

	Frequency	Percent (%)
Cataract	21	40.3
Clear lens	17	32.7
Subluxated	3	5.7
Localised opacity	7	13.4
Dislocated	2	3.8
No view	3	5.7

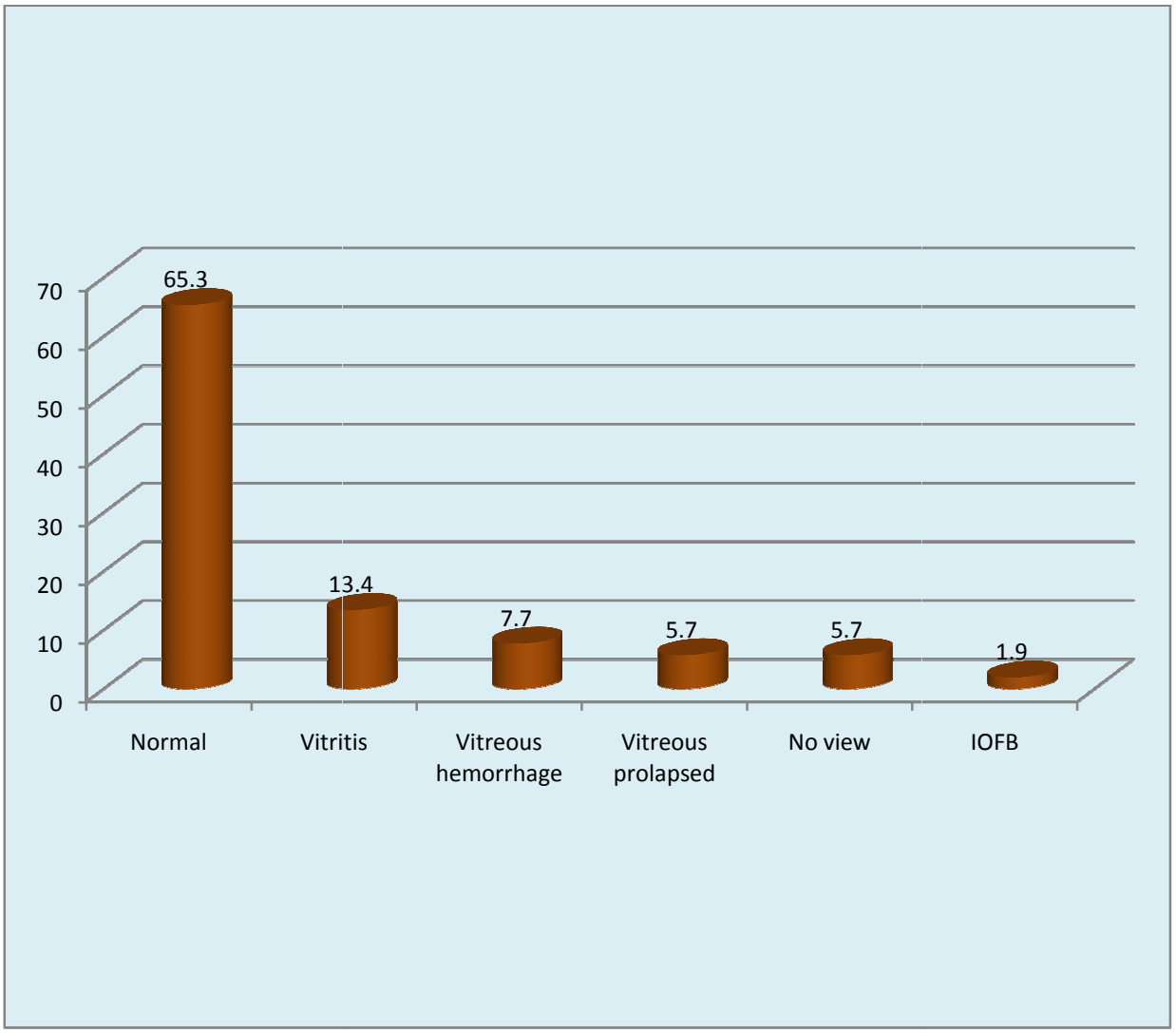
Traumatic cataract was the most common form of lens injury accounting for 40.3%. Lens remained unaffected in 32.3% of patients. In 13.4% of the individuals there was localized opacity. In 5.7% of the patients there was no view of the lens due to hyphema.



14.Posterior segment involvement

	Frequency	Percent (%)
Normal	34	65.3
Vitritis	7	13.4
Vitreous hemorrhage	4	7.7
Vitreous prolapse	3	5.7
No view	3	5.7
IOFB	1	1.9

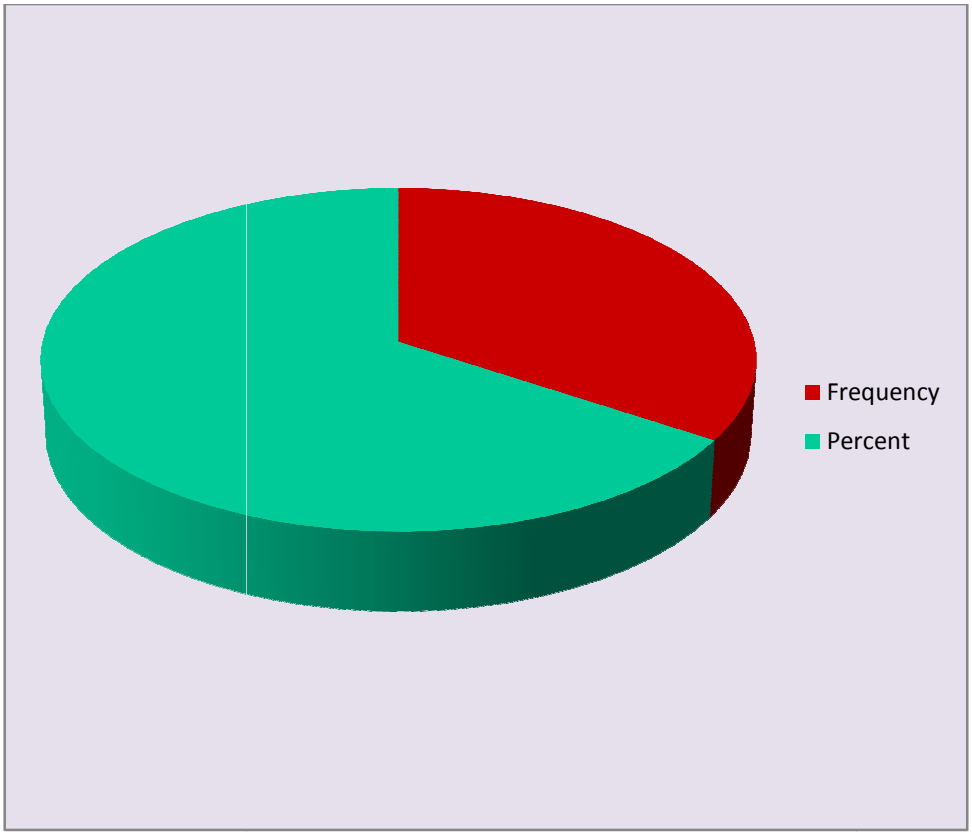
In majority of the patients the posterior segment was normal. Vitreous hemorrhage was present in 7.7% of the patients which was confirmed by ultrasound B scan. In 13.4% of the patients there was vitritis and in 5.7% of patients there was vitreous prolapsed resulting in globe distortion. In 5.7% of the patients there was no view of the posterior segment due to hyphema. There was intraocular foreign body in one patient in the posterior segment.


70
60
50
40
30
20
10
0
65.3
13.4
7.7
5.7
5.7
1.9
Normal
Vitritis
Vitreous hemorrhage
Vitreous prolapsed
No view
IOFB

15.Intraocular foreign body

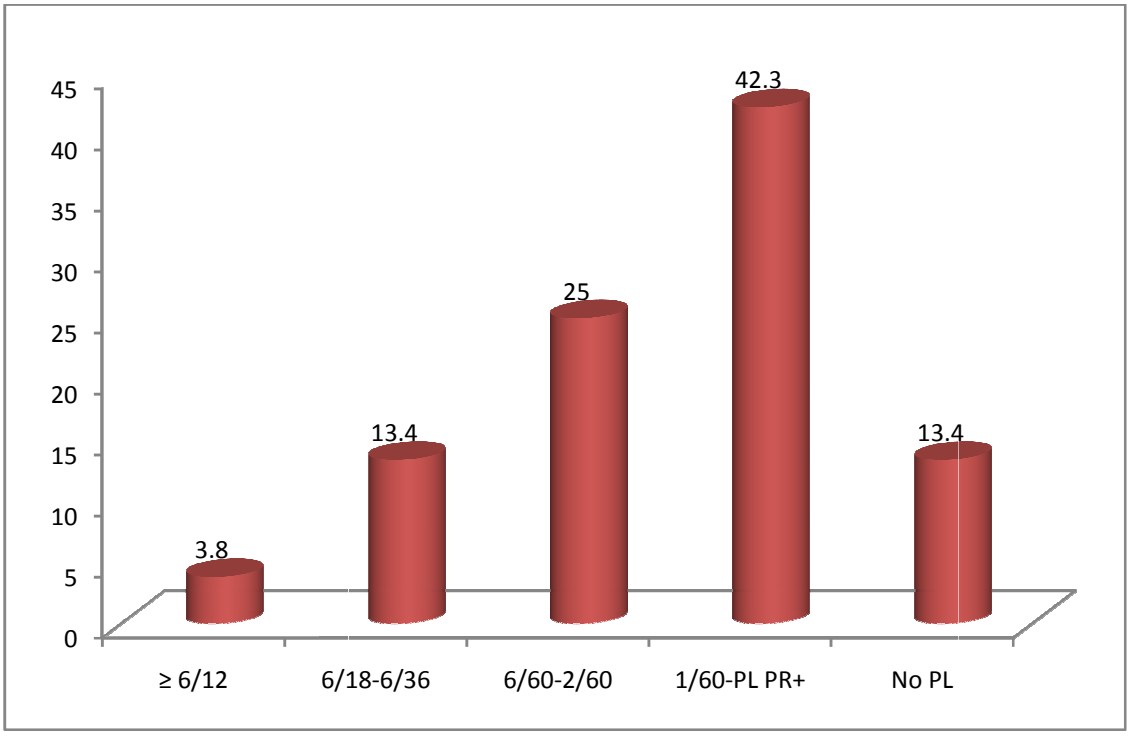
	Frequency	Percent (%)
Absent	50	96.1
Present	2	3.8

In 3.8% of the patients, there was intraocular foreign body.



16.Initial visual acuity

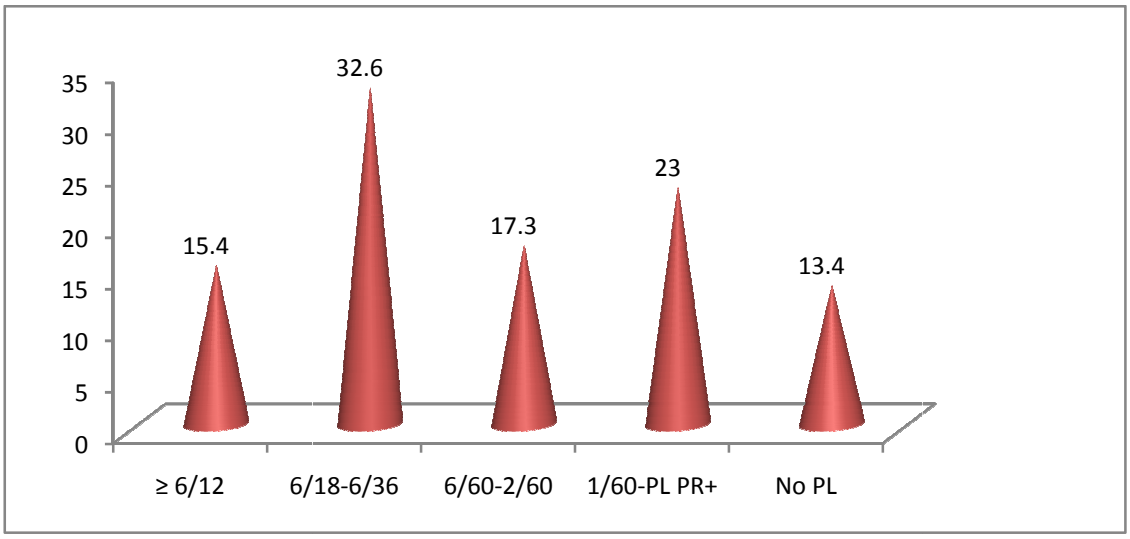
	Frequency	Percent (%)
≥ 6/12	2	3.8
6/18-6/36	7	13.4
6/60-2/60	13	25.0
1/60-PL PR+	22	42.3
No PL	7	13.4



17.Final visual acuity

	Frequency	Percent (%)
≥ 6/12	8	15.4
6/18-6/36	17	32.6
6/60-2/60	9	17.3
1/60-PL PR+	12	23.0
No PL	7	13.4

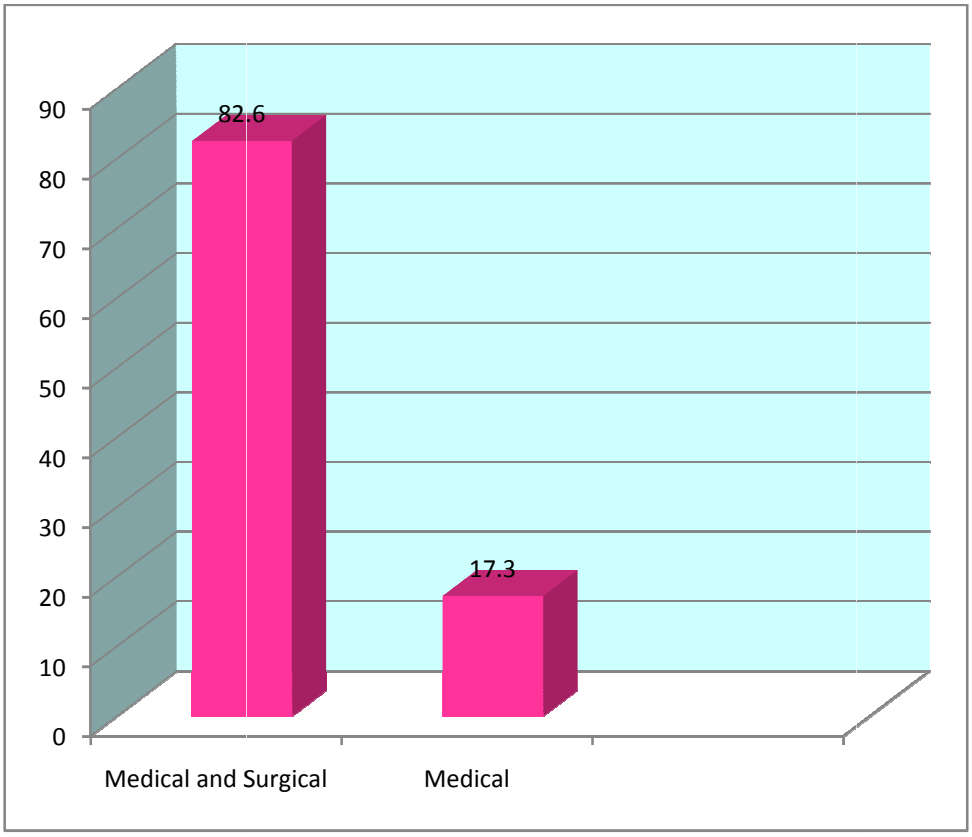
Majority of the patients had a visual acuity ranging between PL PR to 1/60 at the time of presentation. The most common cause of defective vision was traumatic cataract which subsequently improved with treatment. 32.6% of the patients attained a visual acuity ranging between 6/18 and 6/36 after treatment. 13.4% of the patients had no perception of light. This was due to pthisis bulbi and endophthalmitis.



18.Management

	Frequency	Percent (%)
Medical and Surgical	43	82.6
Medical	9	17.3

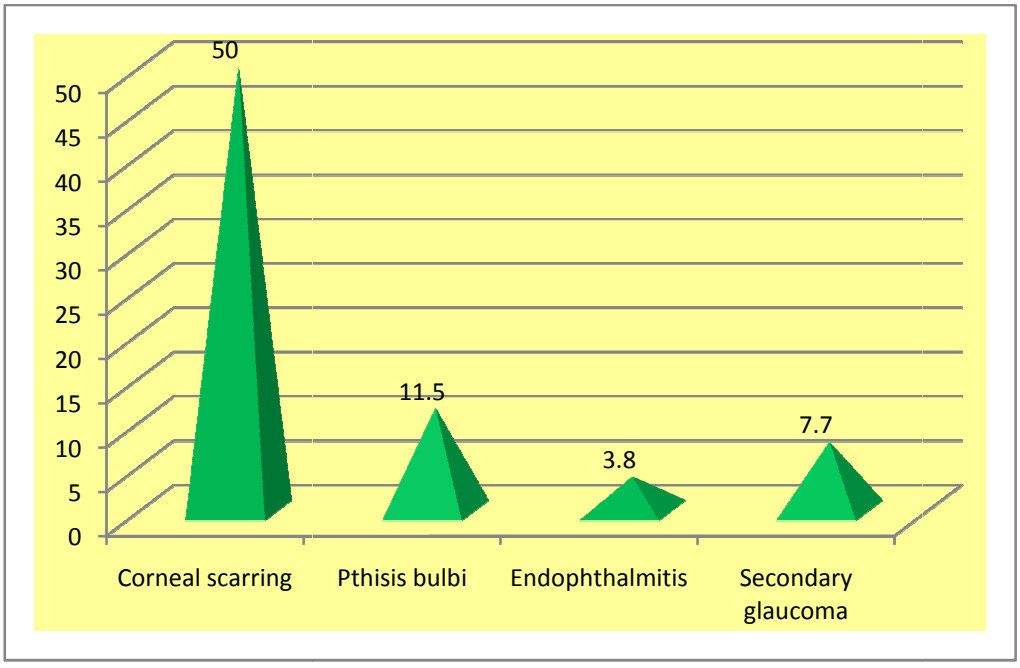
82.6% of the patients required medical as well as surgical management. 17.3% of the patients were treated medically. They had very small tear which was self sealed with formed anterior chamber.



19.Complications and sequelae

	Frequency	Percent
Corneal scarring	26	50.0
Pthisis bulbi	6	11.5
Endophthalmitis	2	3.8
Secondary glaucoma	4	7.7

Majority of the patients (50%) of the patients developed corneal scarring. Pthisis bulbi developed in 11.5% of the patients. 3.8% of the patients developed endophthalmitis. 7.7% of the patients developed secondary glaucoma.



SUMMARY OF RESULTS

A prospective study was conducted at Government Rajaji Hospital, Madurai for a period of Nine months including 52 patients to analyse the risk factors, agents causing injury and visual outcome of the penetrating eye injuries.

Most of the patients with penetrating eye injuries were in the age group16 to 45 years accounting to 65.3%.

Males constituted 76.9% and females were 23.0% among injured. Male to female ratio was 3.33

Right eye was more involved than left eye. Right eye was involved in 51.9% and left eye was involved in 48.1%

34.6% of the penetrating eye injuries were caused by stick followed by thorn which accounted for 19.2%.

38.4% of the patients were injured in domestic setting. 26.9% of the injuries occurred in the fields.

Farmers were most commonly involved accounting to 30. 7%.

44.2% of the injuries were leaking and 55.7% of the injuries were self sealed.

69.2% of the injury were less than 6 mm and 30.8% of the injury were more than 6 mm.

80.7% of the injuries involved zone I and 19.2% of the injury involved zone II.

82.7% of the penetrating eye injury involved the cornea and 17.3% of them involved corneoscleral region.

In 34.6% of the patients anterior chamber was shallow, 25.0% of the patients had iritis, 13.4% of the patients had hyphema and one patient(1.9%) had foreign body in the anterior chamber.

Iris prolapse was the most common form of uveal involvement accounting to 38.9%

40.3% of the patients had traumatic cataract.

In 65.3% of the patients, posterior segment was normal.

In 3.8% of the patients, intraocular foreign body was present.

82.6% of the patients needed both medical and surgical management. 17.3% of the patients were treated medically.

The most common sequelae observed was corneal scarring(50%). Secondary glaucoma developed in 7.7% of the patients. Pthisis bulbi developed in 11.5% of the cases. 3.8% of the patients developed

endophthalmitis. At the time of presentation, 42.3% of the patients had a visual acuity ranging between PL PR to 1/60. After treatment, visual acuity improved to 6/36-6/18 in 32.6%. There was no perception of light in 13.4% of the patients.. This was due to pthisis bulbi and endophthalmitis.

DISCUSSION

Ocular trauma is a major cause of preventable monocular blindness and visual impairment in the world.[21,22] Despite its public health importance, there is relatively less population based data on the magnitude and risk factors for ocular trauma, specially from developing countries.[34,35] Worldwide there are about 1.6 million blind and 19 million unilateral visual loss from eye injuries.[36] 23.5% of the world's blind population is confined to India.[36] NPCB survey in Tamilnadu found that corneal diseases is responsible for 4% of blindness[37]

In our study the commonest age group affected was 16-45 years accounting for 65.38% followed by age group less than 15 years (19.2%). In Israeli ocular injuries study by Ronkoval et al, largest group was in the age group 18-44 years(37.9%).[38] According to Eye injuries: A prospective study of 5671 patients the average age was 30.6 years and 96% were over 10 years.[25] In a study conducted at Goa medical college by Mukherjee AK 44.91% of the patients were less than 30 years of age.[29] According to the study by David et al, patients less than 40 years accounted for 77%.[21]

Our study showed a male: female ratio of 3.3 :1. Males constituted 76.9%. in the study at Goa medical college by AK Mukherjee, males constituted 73.17%.[29] According to Eye injuries: A prospective study of 5671 patients by Caroline J Macewan, males constituted 98.8%.[25] In the study, epidemiology and diagnosis of penetrating eye injuries, males constituted 80%.[21]

RE was slightly more commonly affected than the left eye in our study. In Israeli ocular injuries study by Ronkoval et al, right eye was more affected than left eye.[38] The left eye was more commonly affected than right eye in study of ocular injuries in union territory of Pondicherry.[39] In the study conducted in rural South Wales, there was a slight preponderance of injuries to right eye accounting to 55%.[23]

Wooden particle like stick had been the most common agent of injury in this study accounting to 34.6% . This is due to the fact that the main occupation of the people here is agriculture. According to the study at Goa medical college by AK Mukherjee metallic injuries were commonest reflecting the high incidence of industrial accidents in this developing coastal belt.[29] According to the study, Ocular Trauma in a rural

population of southern India: The Andhra Pradesh Eye Disease Study, injury with vegetable matter like thorn, stick, branch of a tree is the most common agent accounting to 45.3%.[40] According to a study, a 2 year review of ocular trauma in Jimma University Specialized Hospital, wood was the commonest material accounting for 40.9% [41]

In the present study, the commonest place where injury occurred was at home accounting for 38.4% followed by fields(26.9%). In Israeli ocular injuries study by Ronkoval et al, home was the commonest place of injury accounting to 31.8% and followed by work place which accounted for 26.9% .[38] In a study done by B K Malla, injuries at home accounted for as the commonest accounting to 44.5% followed by fields(29.7).[28]

This study shows corneal injury was the commonest to occur accounting to 82.7% of the patients followed by traumatic cataract (40.3%). Iris prolapse was found in 38.4% of the patients. According to the study at Goa medical college by AK Mukherjee, cornea was the commonest structure accounting to 62.21% followed by lens accounting to 56.10%[29]. In a study conducted in rural South Wales, uveal prolapse

was most common finding accounting for 60% followed by corneal injuries accounting for 57%.[23]

Intraocular foreign body was present in 3.8% of the patients in the present study. In the study conducted in rural South Wales, intraocular foreign bodies accounted for 14%.[23] According to Fasina et al, intraocular foreign body was present in 4.4% of the patients.[1] According to Caroline et al intraocular foreign body was present in 0.02% of the patients.[25] According to the Israeli ocular injuries intraocular foreign body was present in 16% of the patients.[38]

In the present study, the patients presented with an initial visual acuity of 1/60 to perception of light in about 42.3% . According to the study by David et al 54% of the patients presented with an initial visual acuity of perception of light to 20/200.[21] In the study , Fasina et al has reported 63% of the patients presented with an initial visual acuity of perception of light to 3/60.[1]

In the present study, 32.6% of the patients attained final visual acuity of 6/18 to 6/36. According to the study by David et al 52% of the patients attained a final visual acuity of 20/200 or better.[21] In a study conducted in rural South Wales, 61% of the patients attained a final visual acuity of

6/12 or better. Initial visual acuity at the time of presentation is the most important prognostic factor regardless of age, type of injury or other factors.[42]

In the present study, 17.3% of the patients required medical management and 82.6% of the patients were treated both surgically and medically. Malla et al reported that 50% of the patients were treated medically and the rest were managed surgically.[28]

The most common sequelae was corneal scarring which accounted for 50% of the cases. Thakker et al and Ray et al reported that the commonest sequelae was traumatic cataract and corneal scarring[43]

CONCLUSION

Eye trauma occurs fairly frequently in developing countries and constitutes major health problem.[29] It is the cause of blindness or partial loss of vision in more than half a million people worldwide.[27]

This prospective study was aimed at describing the risk factors, agents involved and final visual outcome of 52 patients who presented with penetrating eye injuries.

Majority of the patients were in the age group of 16- 45 years representing the working population. The visual impairment in terms of loss of productivity and economic gain can be devastating.

Most penetrating eye injuries are potentially preventable. The improvement in farming techniques should be done. Education should be aimed at young individuals. Penetrating eye injury should also be given importance among the other societal problems. Parental education regarding the danger of sharp toys and air-guns should be emphasized. The use of protective eye wear in both work related as well as recreational activities should be the main focus of preventive education.[21]

When prevention fails and an eye injury occurs early and appropriate referral is very essential to preserve vision.

FIG : 1 CENTRAL CORNEAL INJURY

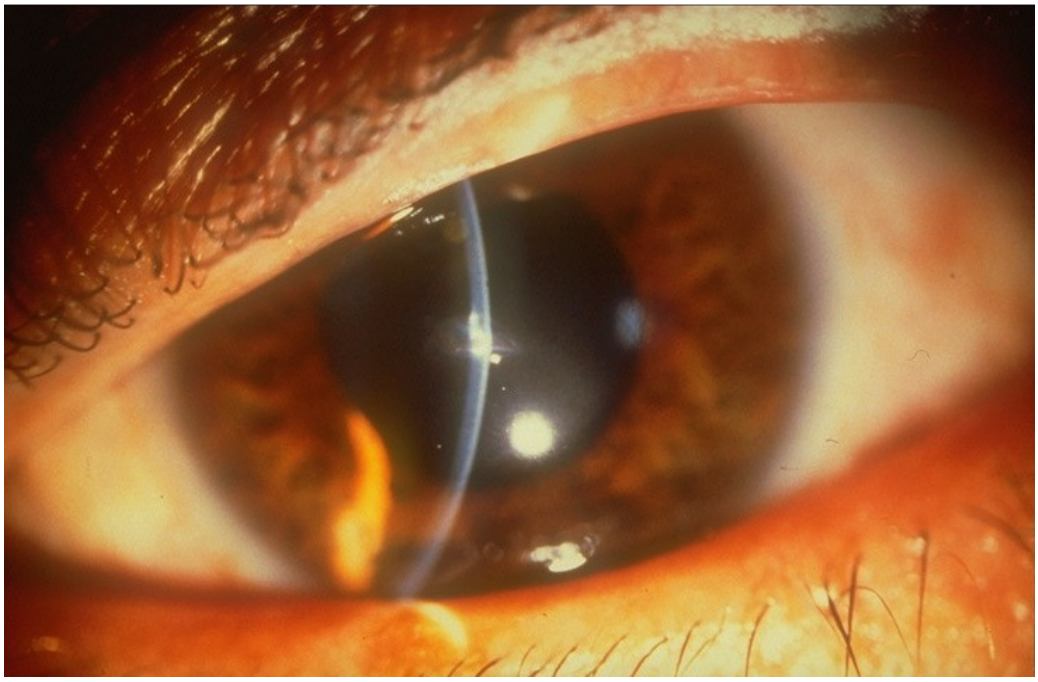


FIG : 2 CORNEAL TEAR REPAIR DONE

FIG :3 CORNEAL INJURY WITH IRIS PROLAPSE

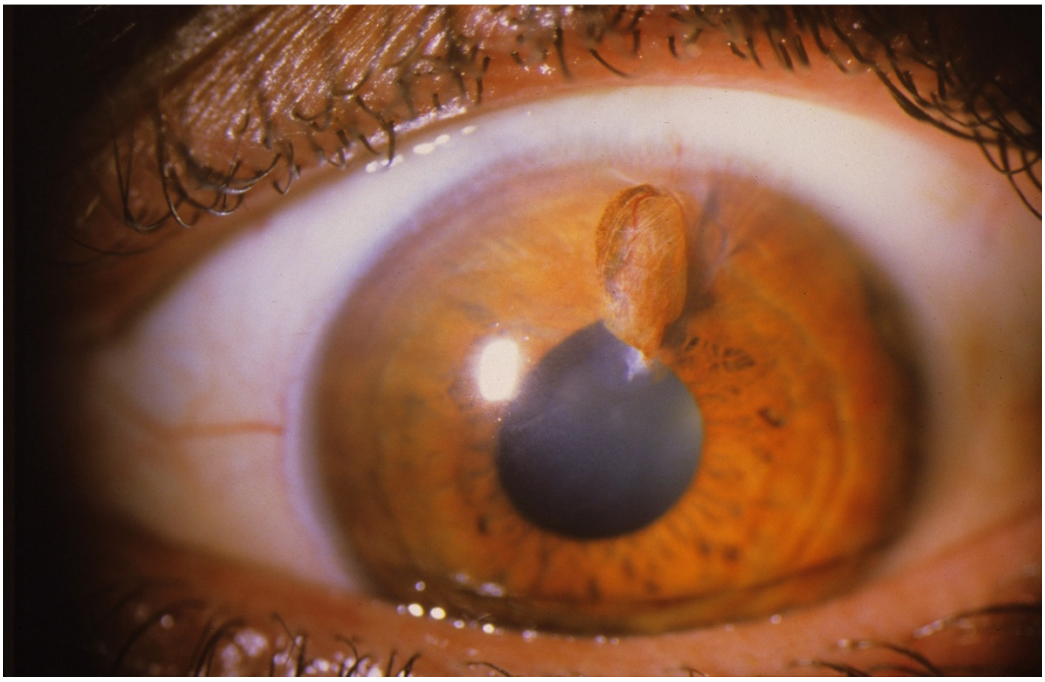


FIG : 4 CORNEAL INJURY WITH IRIS PROLAPSE AND SHALLOW ANTERIOR CHAMBER

FIG : 5 CORNEAL INJURY WITH SHALLOW ANTERIR CHAMBER

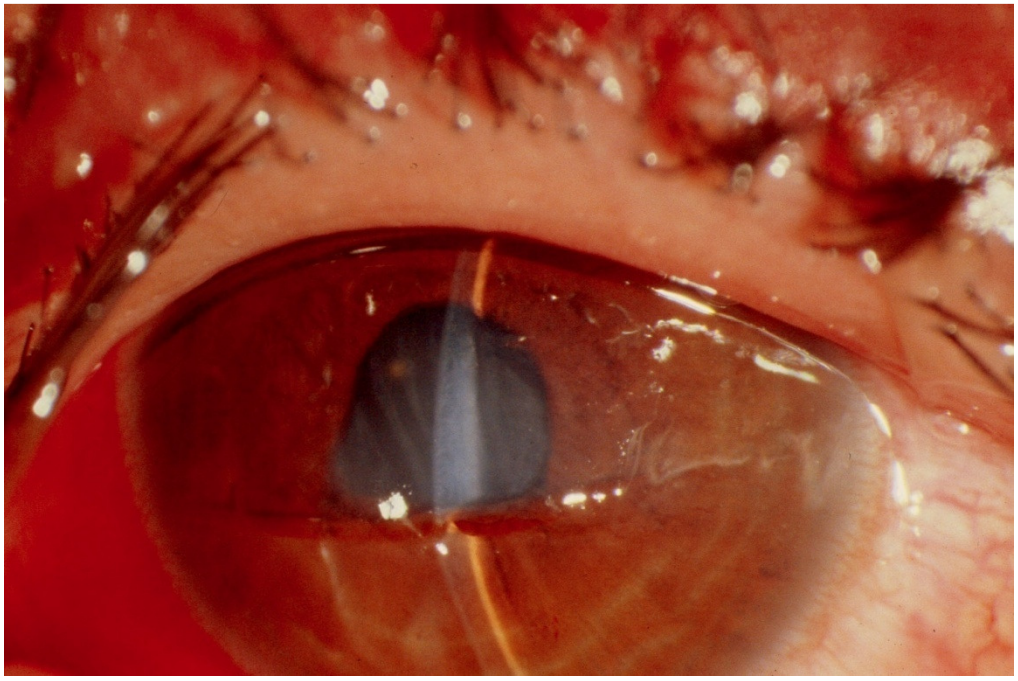


FIG : 6 CORNEOSCLERAL TEAR WITH SHALLOW ANTERIOR CHAMBER, IRIS PROLAPSE AND CHEMOSIS

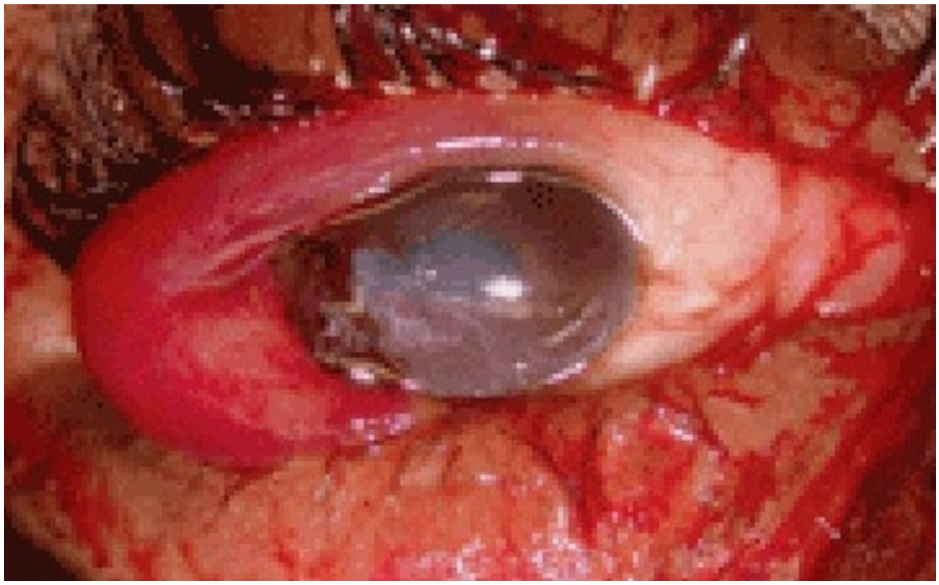


FIG : 7 CORNEAL INJURY REPAIR DONE WITH LENS EXTRACTION

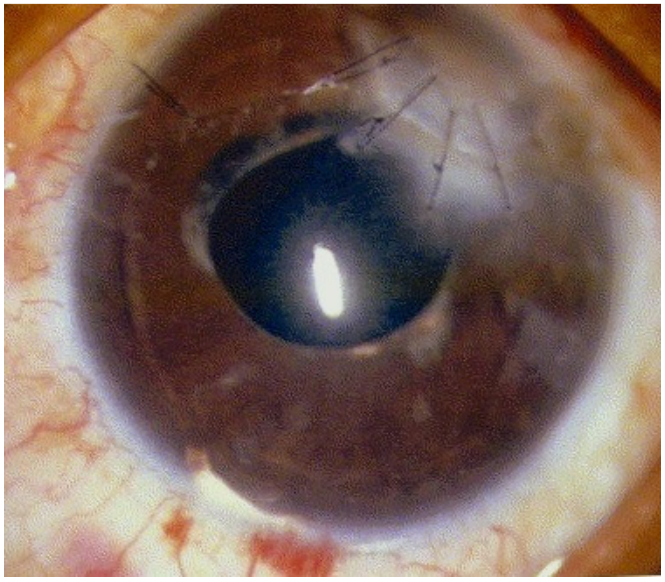
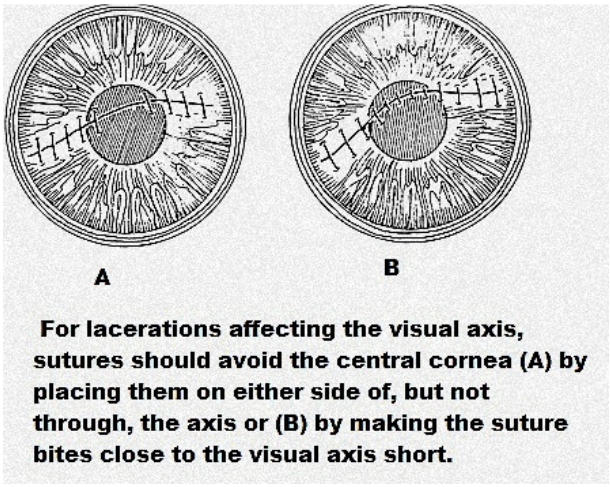


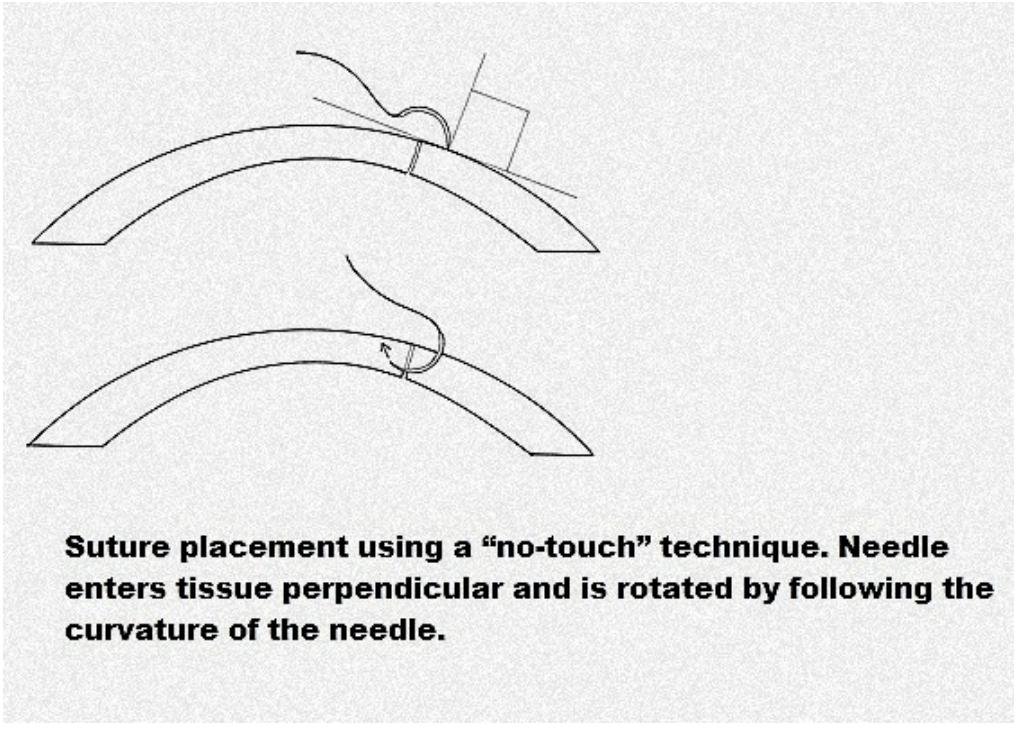
FIG :8 REMOVAL OF FOREIGN BODY FROM ANTERIOR CHAMBER

FIG : 9



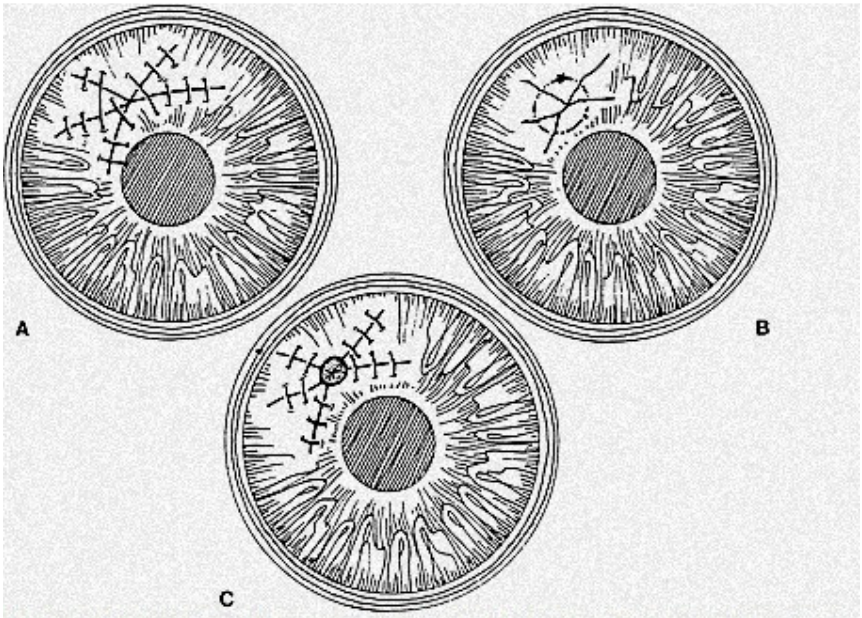
For lacerations affecting the visual axis, sutures should avoid the central cornea (A) by placing them on either side of, but not through, the axis or (B) by making the suture bites close to the visual axis short.

FIG : 10 NO- TOUCH TECHNIQUE FOR CENTRAL AND PARACENTRAL CORNEAL INJURY



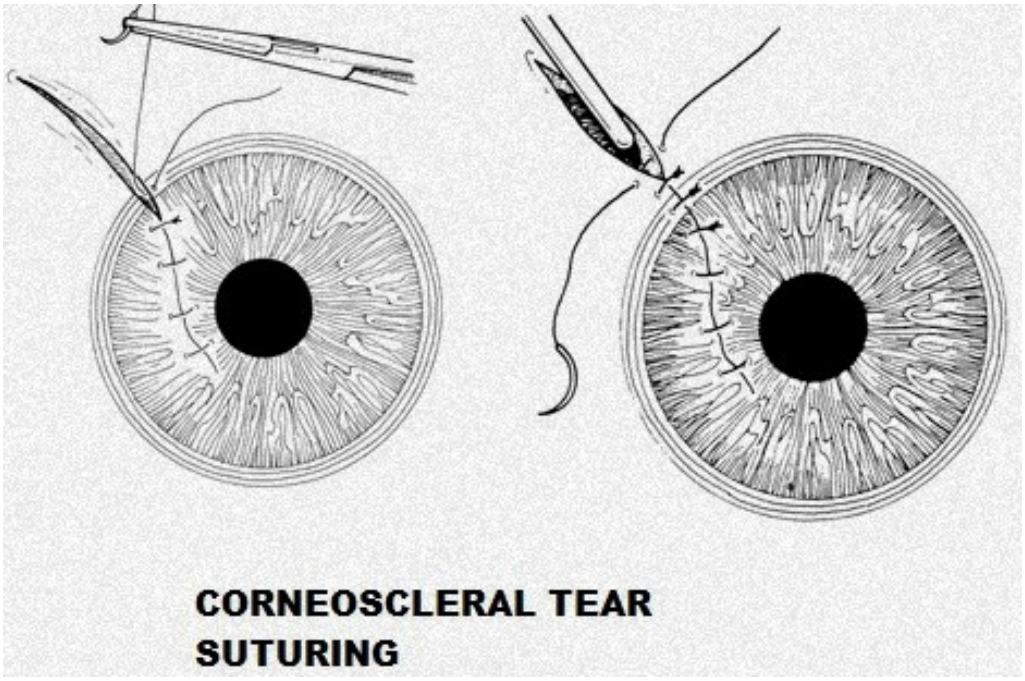
Suture placement using a "no-touch" technique. Needle enters tissue perpendicular and is rotated by following the curvature of the needle.

FIG : 11



Stellate laceration closed by (A) bridging sutures, (B) pursestring suture, and (C) multiple interrupted sutures and tissue adhesive.

FIG : 12



BIBLIOGRAPHY

1. Fasina Oluyemi, Epidemiology of Penetrating Eye Injury in Ibadan. A 10 year hospital based review 2011:18:2;159-163
2. A K Khurana, Indu Khurana, Anatomy and Physiology of Eye, 2nd Edition: 22-24;29-32;35-40
3. Ramanjit Sihota, Radhika Tandon, Parsons' Diseases of the Eye, 19th Edition:7-14
4. Dante J Pieramici, Modern Management of Ocular Trauma: The Classification of Eye Injuries:1:1,2
5. Edgas L Ready, Charles L Tucker, C DouglasWitherspoon, Robert E Morris, Modern Management of Ocular Trauma: General Evaluation of the Traumatic Eye:2:17-25,29
6. Fernando Peniche, Modern Management of Ocular Trauma: Management of Corneoscleral Wounds:4:52-55
7. Irvine J and Smith R: Lens injuries. In Shingleton B, Hersh P, Kenyon K (eds). Eye Trauma Mosby,1991,11:126-135
8. Denise de Frientas, Modern Management of Ocular Trauma: Anterior segment Trauma:5:58,59

9. William J Wirostko, Rama D Jagar, Robin Singh, Daniel Kiernan, William F Mieler, Modern Management of Ocular Trauma: Intraocular foreign bodies:8:91-94
10. Coleman DJ, Lucas BC, Rondeau MJ, Chang S: Management of Intraocular Foreign Bodies. Ophthalmol 94:1647-53,1987
11. Ros WH, Tasman WS: The Management of Magnetic Intraocular Foreign Bodies. Can J Ophthalmol 10:168-73, 1975
12. Hadden DB, Wilson JL: The Mangement of Intraocular Foreign Bodies, Aust New Zealand J Ophthalmol 18: 343-51, 1990
13. De Bustros S: Posterior Segment Intraocular Foreign Bodies as In: Shingleton SJ, Hersh PS, Kenyon KR, eds: Eye Trauma. St. Louis: Mosby- Year Book, Inc; 1991
14. William DF, Mieler WF, Abrams GW, Lewis H: Results and Prognostic factors in Penetrating Ocular Injuries with sustained Intraocular Foreign Bodies. Ophthalmol 95:911-6;1988
15. David F, Williams DF, Mieler WF, William GA: Posterior Segment Manifestation of Ocular Trauma. Retina 1990;10 Suppl 1:S35-44
16. Rohan W. essex, et al : Post Traumatic Endophthalmitis, Ophthalmities, Ophthalmology, 2004(111) 2015-2022

17. Thompson JT, Parves LM, Enger CL et al: Infectious Endophthalmitis after Penetrating Eye Injuries with Retained Intraocular Foreign Bodies. Ophthalmol 100: 1468-74, 1993
18. Mieler WF, Ellis MK, William DF, Han DP: Retained Intraocular Foreign Bodies and Endophthalmitis Ophthalmol 97:1532-38,1990
19. Boldt HC, Pulido JS, Blodi CF, et al: Rural ENdopthalmitis Ophthalmol 96:1772-6,1989
20. Alfaro DV, Roth D, Ligegett PEP: Post Traumatic Endophthalmitis: Causative organisms, treatment, and prevention. Retina 14:206-11,1994
21. David Smith, Keith Wrenn, Lawrence B Stack, The Epidemilogy and Diagnosis of Penetrating Eye Injuries. Academic Emergency Medicine; 2002(9)(3)
22. Hany E El Mekawey, Khaled G Abu El Einen, Mohammad Abdbdel, Amr Khafagy, Eman M Eltahawy Epidemiology of ocular emergencies in Egyptian : a five year retrospective study; Clin Ophthalmol.2011;5 955-960
23. C G Thompson, RKS Griffits, W Nardi, MP Teestu, MJ Noble, l Cotter and P Weis. Penetrating Eye Injuries in rural New South

Wales, Australian and New Zealand Journal of Ophthalmology,1997(25):37-41

24. B C K Patel, Penetrating Eye Injuries, Archives of Disease in Childhood,1989:64:317-320

25. Caroline J Macewan, Eye Injuries: A prospective survey of 5671 cases, British Journal of Opthalmology, 1989:73,888-894

26. M E Gyasi, WMK Amoaku, M A Adjuik. Epidemiology of Hospitalised Ocular injuries in the Upper East Region of Ghana. Ghana Med J 2007:41(4):171-175

27. Usha Vasu, Andrew Vasnaik, R R Battu, Mathew Kurien, Sony George, Occupational open globe injuries, Indian Journal of Ophthalmology:2001:49:1,43-47

28. Malla BK: Structural change in ocular trauma and visual outcome. Kathmandu University Medical Journal :2003:2:2:6;1132-1138

29. AK Muherjee, J S Saini, SM Dabral, A profile of penetrating eye injuries. Indian Journal of Ophthalmology; 1984(32):5:269-271

30. W N Wykes, A 10 year survey of Penetrating eye injuries in Gwent, 19776-85,, British Journal of Ophthalmology, 1988,72, 607-611.

31. Michael Ilsas, Moses Chirambo, Michael Belkin. Ocular injuries in Malawi. British Journal of Ophthalmology, 1982:66:145-148.

32. Barry A, Maltzmann Howard Druzen S and Michael L, Mund. Survey of Ophthalmology 21::3-1976

33. Jazy Malckiewicz, Machowicz-Mateiko, Monika Salaga-Pylek, Marta Piecyk-Sidor, Zbignien,Ann agric Environ Med 2005:12, 27-29

34. Katz J Tielsch JM, Lifetime prevalence of ocular injuries from the Baltimore Eye Survey. Arch Ophthalmol.1993;111:1564-8

35. Schein OD, Hibberd P, Shingleton BJ, Kunzweiler T, Frambach DA, Seddon JM, et al. The spectrum and burden of ocular injury. Ophthalmology. 1998;95:300-5

36. Dandona L, Dandona R, Srinivas M, John RK,Mc Carty, Rao GN. Ocular trauma in an urban population in Southern India. The Andhra Pradesh Eye Disease Study. Clin Exp Ophthal. 2000;28:350-5

37. Nirmalan PK, Katz J, Tielsch JM, Robin AL, Thulasiraj RD, Krishnadas R , et al. Ocular trauma in a rural South India population : The Arvind Comprehensive Eye Survey Ophthalmology. 2004;111:1778-81

38. Ron koval et al – The Israeli Ocular Injuries study. Arch Ophthalmol – Vol 106, June 1988

39. Krishnan, Sreenivasan. Ocular injuries in Union Territory of Pondicherry – Clinical presentation. Indian J Ophthalmol 1988; 36(2):82-85

40. Sannapaneni Krishnaiah, Praveen K Nirmalan, Bindiganavale R Shamanna, Marmamula Srinivas, Gullapalli N Rao, Ravi Thomas. Ocular Trauma in a rural population of Southern India. The Andhra Pradesh Eye Disease Study, Ophthalmology 2006:113(7);1159-1164

41. Tsedeke Asaminew, Yeshigeta Gelaw, Fessehaye Alemseged, A 2 year review of Ocular Trauma in Jimma University Specialized Hospital 19:2;67-74

42. Paul Sternber, Eugene De Juan, Ronald A, Michael, Cheryl Aura. Multivariate analysis of prognostic factors in penetrating ocular injuries. Amer J Ophthalmol:98;467-472,1984

43. Thakker HM, Ray S. Vision limiting complication in open globe injuries. Can J Ophthalmol:2006 Feb 41(1) 86-89

44. G S Brinton, T M Topping, RA Hyndiuk, T M Aaberg, J H Reeser, G W Abrams. Post traumatic endophthalmitis, Arch Ophthalmol: 1984:102:547-550.

45. Thulasiraj RD, Rahmathulla R, Saraswathi et al, Sivaganga eye survey- Blindness and cataract surgery, ophthalmic Epidemiol:2002:9:299-312

46. Negrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiology, 1998:5(3)143-69

47. Mohan M Survey of Blindness in India 1986-1989. Present status of national programme of control of Blindness. Ministry of Health and Family Welfare, Government of New Delhi:1992:80-100

PROFORMA

PENETRATING EYE INJURIES

Name :

I.P./OP No :

Age :

Sex :

Agent :

1. Stick
2. Stone
3. Needle
4. Thorn
5. Pencil
6. Glass
7. Metallic objects
8. Contact lens
9. Others (specify)

Place of injury:

1. Domestic
2. Fields
3. Factory / Work place
4. Road
5. Playground
6. School

7. Others

Occupation :

1.Farmer

2 Factory worker

3. Student

4. Housewife

5. others

Laterality

1. RE 2. LE 3. Both eyes

Time lapse before attending this institution:

Prior treatment taken if any :

Use of protective eye wear :

VA (unaided) at the time of examination

	RE	**LE**
1. ≥ 6/12		
2. 6/18-6/36		
3. 6/60-2/60		

4. 1/60-PL

5. no PL

Orbit :

Lacrimal drainage apparatus :

Conjunctiva :

Sclera :

Cornea :

Size

Zone

Leaking / sealed

Infection

Foreign body

Anterior chamber :

Iris :

Pupil :

Size

Shape

Reaction to Light

Lens :

- Clear

- Cataract

- Localised opacity

- Subluxation

- Dislocation

- Other

Vitreous :

- normal

- Vitritis

- IOFB

- VH

- Others

Fundus :

- normal

- abnormal (specify)

- no view

X ray

- Radio opaque FB

- Bony fracture

CT scan

US(B scan)

- Vitreous hemorrhage

- Retinal detachment

- IOFB

- Others (specify)

Management

Medical

Topical □

Oral □

Parenteral □

Surgical

Lid suturing

Corneal tear repair

Corneoscleral tear repair

Corneoscleral tear repair + iris prolapse excision

Corneoscleral tear repair with lens removal

Corneal tear repair + Pars plana vitrectomy + IOFB removal

ECCE with IOL

Others (retinal detachment surgery, trabeculectomy)

Enucleation

Final visual acuity after 3months

RE

LE

Sequalae

1. Phthisis bulbi

2. Secondary glaucoma

3. Vitreous hemorrhage

4. Endophthalmitis

5. Corneal scarring

6. Sympathetic ophthalmitis

ANNEXURE

St	-	student
Far	-	farmer
Fa	-	factory worker
HW	-	housewife
Oth	-	others
D	-	domestic
Fi	-	fields
WP	-	workplace
R	-	road
Pl	-	playground
Sc	-	school
CW	-	Corneal Wound
L	-	leaking
S	-	sealed
C	-	central
PC	-	Paracentral
P	-	peripheral
CST	-	Corneoscleral tear
N	-	Normal
AC	-	anterior chamber
PS	-	posterior segment
CP	-	colour pattern

IOFB - intraocular foreign body

CTR - corneal tear repair

CSTR - corneoscleral tear repair

IPE - iris prolapse excision

ECCE - Extracapsular cataract extraction

SICS - small incision cataract surgery

IOL - intraocular lens

VA - Visual Acuity

PL - perception of light

HM - hand movements

CFCF - counting fingers close to face

PR - Projection of rays

1- Stick

2- Stone

3- Thorn

4- Metallic object

5- Glass

6- Pencil

7- Others

* - $\leq$ 6mm

** - > 6mm

MASTER CHART

S No.	NAME	AGE/SEX	OCC	INJURY	AGENT	EYE	CW	TIME OF PRESENTATION	ZONE	WOUND	ASSO FINDINGS	Initial VA	Final VA	MANAGEMENT	SEQUELAE
1	Karthick	8/M	St	Sc	6	RE	S	12h	I	*PC	N AC;N Iris;clear lens;N PS	6/18	6/9	CTR	-
2	Chellayya	50/M	Far	D	2	LE	L	1d	II	**C+PC+P	Shallow AC;Iris prolapse;cataract;N PS;	HM	6/36	CTR+IPE+AC reformation+ECCE+IOL(secondary)	corneal scarring
3	Nagaraj	30/M	Fa	D	2	RE	L	1d	II	*CST-P+PC	Shallow AC;Iris prolapse;subluxated lens;N PS	PL+PR+	PL	CSTR+IPE+AC reformation+ECCE+ACIOL(secondary)	corneal scarring
4	leelavathy	35/F	HW	D	2	RE	L	6h	II	**CST-C+PC+P	Hyphema;Iris prolapse;dislocated lens;vitreous prolapse	No PL	No PL	CSTR+IPE+AC wash+anterior vitrectomy	pthisis bulbi
5	Andi	32/M	Far	Fi	3	LE	S	1d	I	*C+PC	N AC;N Iris;clear lens;N PS	6/60	6/24	Medical	-
6	Murugan	38/M	Far	D	1	RE	S	2d	I	*C+PC	AC-cells,flare;Iris-CP altered;cataract;N PS	1/60	6/24	Medical+ECCE+IOL(secondary)	corneal scarring
7	Velu	48/M	Far	Fi	1	LE	S	1d	I	*PC+P	N AC;N Iris;cataract;N PS	1/60	6/18	Medical+ECCE+IOL(primary)	corneal scarring
8	Panchavarnam	36/F	HW	D	7	RE	S	5d	I	*PC	N AC;N Iris;cataract;N PS	3/60	6/18	Medical+ECCE+IOL(primary)	-
9	Shanmugam	42/M	Far	D	1	RE	L	1d	I	*PC+P	Shallow AC;Iris prolapse;cataract;N PS	2/60	6/36	CTR+IPE+AC reformation+ECCE+IOL(secondary)	corneal scarring
10	Ramu	70/M	Far	Fi	1	LE	L	6d	I	*P+PC	Shallow AC;CP altered;cataract;vitritis	No PL	No PL	Medical+CTR+AC reformation	endophthalmitis
11	Muthu	40/M	Oth	D	1	RE	L	2d	I	**C+PC+P	Shallow AC;Iris prolapse;cataract;N PS	HM	1/60	CTR+IPE+AC reformaation+ECCE+IOL(secondary)	corneal scarring
12	Mariappan	30/M	Fa	Fi	3	LE	S	1d	I	*PC	AC cells+;CP altered;clear lens;N PS	6/60	6/36	Medical	corneal scarring
13	Muthudevar	41/M	Fa	WP	2	LE	S	7d	I	*C+PC	AC shallow;cells+;cataract;vitreous hemorrhage;IOFB in AC	PL	PL	CTR+AC reformation+IOFB removal+medical;	secondary glaucoma
14	lakshmi	7/F	St	P	1	RE	S	6h	I	*PC	N AC:N Iris;clear lens;N PS	6/60	6/18	CTR	corneal scarring
15	Palani	43/M	Far	Fi	3	LE	L	3d	I	*PC+P	Shallow AC;iris prolapse;cataract;vitritis	PL	CFCF	Medical+AC reformation+CTR+IPE+ECCE+IOL(secondary)	corneal scarring
16	Pandian	39/M	Far	Fi	1	RE	L	1d	II	**CST-PC+P	Hyphema;iris prolapse;no view of lens and PS	No PL	No PL	CSTR+IPE+AC wash	pthisis bulbi

17	Chinnan	33/M	Fa	D	2	RE	S	1d	I	*P	CP altered;AC cells+;N lens;N PS	6/60	6/12	Medical	-
18	Manikandan	12/M	St	P	1	RE	S	6h	I	*PC	N AC; Iris;clear lens;N PS	6/60	6/12	CTR	corneal scarring
19	Durairaj	29/M	Oth	R	5	LE	L	6h	II	**CST-PC+P	Hyphema;iris prolapse; no view of lens and PS;lid tear	PL	PL	CSTR+IPE+lid repair+AC wash	pthisis bulbi
20	Rasu	52/M	Far	Fi	1	RE	L	6d	II	**CST-PC+P	Hyphema;iris prolapse;cataract;vitritis	No PL	No PL	CSTR+IPE+AC wash+Medical	endophthalmitis
21	Backiam	42/F	HW	D	1	LE	S	3d	I	*C	AC cells+;CP altered;cataract;N PS	HM	6/36	Medical+SICS+IOL(secondary)	corneal scarring
22	Sethu	13/M	St	D	3	LE	S	12h	I	*P	N AC;N Iris;clear lens;N PS	6/18	6/9	Medical	-
23	Raman	36/M	Fa	WP	4	RE	L	12h	II	**CST-PC+P	Hyphema;iridodialysis;subluxated lens;vitreous prolapse;IOFB in anterior vitreous	No PL	No PL	CSTR+AC wash+anterior vitrectomy	pthisis bulbi
24	Kandasamy	41/M	Far	Fi	1	LE	L	2d	I	**C+PC+P	Shallow AC;iris prolapse;cataract;vitritis	PL	PL	CTR+IPE+AC reformation+ECCE+IOL(secondary)	corneal scarring
25	Dharmaraj	35/M	Oth	R	7	LE	S	1d	I	*C	AC cells+;CP altered;clear lens;N PS	CFCF	6/36	Medical	corneal scarring
26	Petchi	37/F	HW	D	1	RE	S	1d	II	*CST+P	Shallow AC;CP altered;localised opacity;N PS	6/60	6/36	CSTR+IPE+AC reformation+ECCE+IOL(secondary)	corneal scarring
27	Kumaran	6/M	St	Sc	6	RE	S	4h	I	*P	N AC;N Iris;clear lens;N PS	6/12	6/9	CTR	-
28	Arumugam	58/M	Far	Fi	3	LE	L	4d	I	*PC+P	Shallow AC;iris prolapse;cataract;vitritis	PL	2/60	CTR+IPE+AC reformation+medical+ECCE+IOL(secondary)	corneal scarring
29	Gnanaraj	30/M	Fa	WP	4	RE	L	3d	I	*C+PC	Shallow AC;iris prolapse;localised opacity;vitreous hemorrhage	PL	CFCF	CTR+IPE+AC reformation	secondary glaucoma
30	Pandiammal	31/F	Far	Fi	3	RE	S	2d	I	*PC	AC cells+;CP altered;cataract;N PS	3/60	6/60	Medical+ECCE+IOL(secondary)	corneal scarring
31	Palraj	7/M	St	Sc	6	LE	S	4h	I	*P	N AC;N Iris;clear lens;N PS	.6/18	6/9	CTR	-
32	Mayandi	56/M	Far	Fi	3	RE	L	6d	I	*PC+P	Shallow AC;iris prolapse;cataract;vitritis	PL	1/60	CTR+IPE+AC reformation+Medical+ECCE+IOL(secondary)	corneal scarring
33	Perumal	40/M	Fa	WP	4	LE	S	1d	I	*PC	AC cells+;CP altered;cataract;N PS	2/60	6/36	Medical+SICS+IOL(secondary)	corneal scarring
34	Venkatasamy	39/M	Oth	R	5	LE	L	1d	I	**PC+P	Shallow AC;iris prolapse;localised opacity;N PS	1/60	6/36	CTR+IPE+AC reformation+ECCE+IOL(primary)	corneal scarring

35	Saroja	34/F	HW	D	1	RE	L	5d	I	**C+PC+P	Shallow AC;iris prolapse;localised opacity;vitritis	PL	PL	CTR+IPE+AC reformation+medical	corneal scarring
36	Andiappan	47/M	Fa	WP	4	RE	L	12h	II	**CST-PC+P	Hyphema;iridodialysis;no view of lens and PS;lid tear	No PL	No PL	CSTR+lid tear repair+AC wash	pthisis bulbi
37	Muthuvel	9/M	St	P	2	RE	S	6h	I	*P	N AC;N Iris;clear lens;N PS	6/12	6/9	CTR	-
38	Thangaraj	10/M	St	D	1	LE	S	12h	I	*PC	N AC;N Iris;clear lens;N PS	6/24	6/18	CTR	-
39	Kasammal	40/F	Far	Fi	3	RE	S	2d	I	*P	AC cells+;CP altered;cataract;N PS	2/60	6/60	Medical+SICS+IOL(secondary)	corneal scarring
40	Veeran	38/M	Fa	WP	4	LE	L	5h	II	**CST-C+PC+P	Hyphema;iridodialysis;dislocated lens;vitreous prolapse	No PL	No PL	CSTR+AC wash+anterior vitrectomy	pthisis bulbi
41	Murugayee	37/F	HW	D	1	RE	L	2d	I	**PC+P	Shallow AC;iris prolapse;localised opacity;N PS	HM	6/60	CTR+IPE+AC reformation+ECCE+IOL(secondary)	corneal scarring
42	Ahmad	33/M	Oth	R	7	RE	L	3d	I	**C+PC+P	Shallow AC;iris prolapse;localised opacity;vitreous hemorrhage	PL	1/60	CTR+IPE+AC reformation	secondary glaucoma
43	Das	9/M	St	D	1	LE	S	10h	I	*PC	N AC;N Iris;clear lens;N PS	6/24	6/18	CTR	-
44	Ammaponnu	41/F	HW	D	7	LE	S	3d	I	*C	AC cells+;CP altered;cataract;N PS	HM	4/60	Medical+SICS+IOL(secondary)	corneal scarring
45	Karuppan	51/M	Far	Fi	3	RE	S	3d	I	*PC	AC cells+;CP altered;cataract;N PS	1/60	6/60	Medical+ECCE+IOL(secondary)	corneal scarring
46	Thangavel	8/M	St	D	1	LE	S	1d	I	*PC	N AC;N Iris;clear lens;N PS	6/36	6/12	CTR	-
47	Rajathi	29/F	Far	Fi	3	LE	S	4d	I	*PC	N AC;N Iris;clear lens;N PS	6/24	6/18	medical	corneal scarring
48	Ganesan	27/M	Fa	WP	4	RE	S	1d	I	*C+PC	N AC;N Iris;clear lens;N PS;	*	6/60	Medical	corneal scarring
49	Palaniammal	39/F	HW	D	2	RE	L	3d	I	**C+PC+P	Shallow AC;iris prolapse;cataract;vitreous hemorrhage	PL	PL	CTR+IPE+AC reformation+ECCE+IOL(secondary)	secondary glaucoma
50	Rasappan	31/M	Fa	WP	4	LE	L	1d	I	**C+PC+P	Shallow AC;iris prolapse;localised opacity;IOFB in PS	HM	1/60	CTR+IPE+AC reformation+vitrectomy&IOFB removal	corneal scarring
51	Thiyagu	36/M	Oth	D	1	LE	S	3d	I	*C+PC	AC cells+;CP altered;cataract;N PS	3/60	6/60	Medical+SICS+IOL(secondary)	corneal scarring
52	Palsamy	29/M	Fa	WP	4	LE	S	1d	I	*PC	N AC;N Iris;clear lens;N PS	5/60	6/36	Medical	corneal scarring