STUDY ON CHARACTERISTICS AND OUTCOME OF PAEDIATRIC EYE INJURIES (SCOPE)

Dissertation submitted for

MS (Branch III) Ophthalmology

The Tamil Nadu Dr. M.G.R. Medical University

Chennai

April 2011

CERTIFICATE

Certified that this dissertation entitled **"Study on Characteristics and Outcome of Paediatric Eye Injuries (SCOPE)"** submitted for the Master of Surgery (Branch III) Ophthalmology, is a bonafide work done by ***DR.M.PURUSHOTHAMA RAJKUMAR*** under our supervision and guidance in the Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Madurai during his residency period from May 2008 to April 2011.

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ACKNOWLEDGEMENT

I acknowledge with gratitude my chief guide Dr.M.Srinivasan, Director-Emeritus, Aravind Eye Hospital, Madurai and my mentor Dr. Jeena Mascarenhas, Asst. Professor, Cornea Services, Aravind Eye Hospital, Madurai for her dynamic guidance and encouragement without which this dissertation wouldn't have been made possible. Her valuable suggestions and patronage has been a driving force to make this endeavor possible.

I would also like to pay my respects to our founder, Dr. G. Venkataswamy, whose dynamism and vision brought about the origin of this great institution.

I deem it an honour to express my heartfelt gratitude to Dr.Prajna, Chief, Cornea services, Dr.R.D.Ravindran, Chairman, Dr.P.Namperumalsamy, Chairman-Emeritus, Dr.G.Natchiar, Director HRD, Dr.P.Vijayalakshmi, Chief, Paediatric Ophthalmology, Dr.Rathinam, Chief, Uvea Services, Dr.Krishnadas, Chief, Glaucoma Services, Dr.Kim, Chief, Retina Department, Dr.Usha Kim, Chief, Orbit and Oculoplasty, Dr. Lalitha Prajna, Chief, Department of Microbiology and Dr.Haripriya Aravind, Chief, Cataract Services. Their perseverance, single minded and dedicated approach to work, have been a great source of inspiration. It was a great privilege to have been trained by them all.

I would like to thank all Cornea services sisters including Sr.Jayachandra and all Medical Records Department (MRD) sisters including Sr.Lakshmi Gandhi for their kind cooperation. My special thanks to the librarian Mrs. Kumaragurupari for her help and valuable support during my study.

I would also like to thank staffs of Media Nett, for their admirable effort, meticulous attention and patience in computer analysis.

I am grateful to my friends and colleagues for their unwavering support.

I will be failing in my duties if I do not acknowledge my sincere thanks to the study subjects without whom this work would not have been possible.

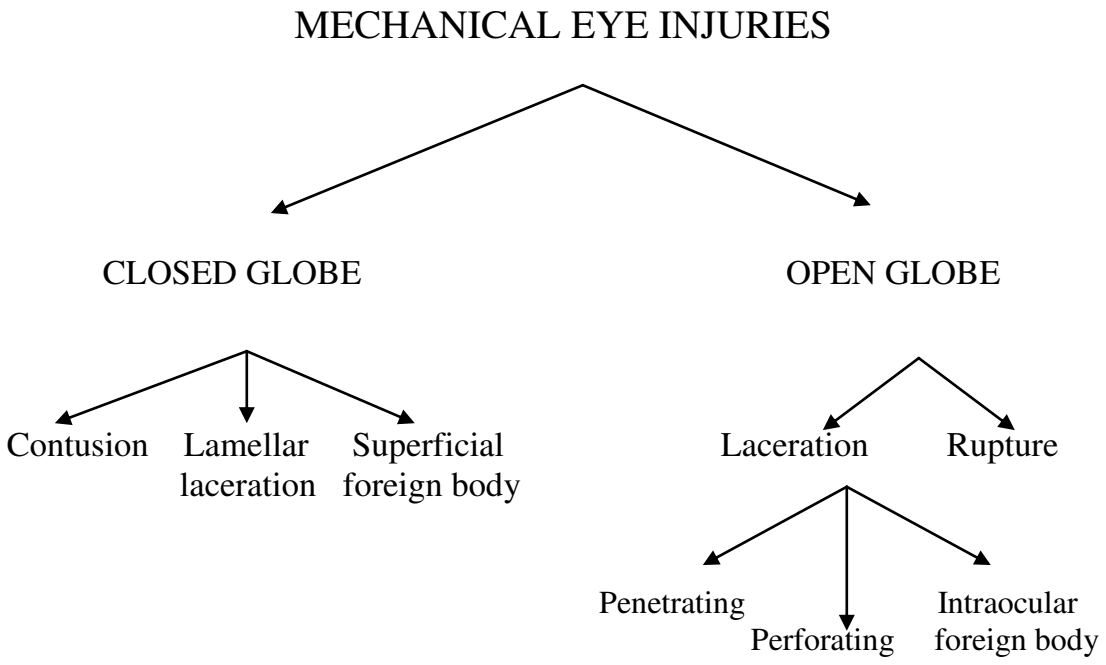
Last but not the least, I would like to thank my parents. If not for their love and sacrifices, I would not have been what I am this day.

CONTENTS

PART - 1

CONTENTS: PART – II

CLASSIFICATION OF OCULAR INJURIES



INTRODUCTION

In India, ocular injuries have been identified as the major cause of acquired monocular blindness in children.[1] They account for approximately 8–14% of total injuries in children and are the most common type requiring hospitalization (in up to 40% cases).[2] It continues to be a major public health problem in our country and assumes special importance in children due to the number of years of blindness and the loss of man-hours that ensues.

The weakness of the infantile cornea, the thin and elastic anterior lens capsule, and the firm vitreous with its strong adherence to the retina bear particular intra and post-op problems.[3] Epidemiological studies are needed to permit a more accurate planning for prevention and management measures, a standardized international template for reporting on eye injuries might be useful to this effect.[4-5]

MAGNITUDE OF BLINDNESS WORLDWIDE

Age-specific prevalence of blindness and number of blind people, by age and WHO sub region, 2002 [#, 6]

WHO Subregion	Prevalence			Number (Millions)		
	<15yrs of age	15-49 Yrs	>50 yrs	<15yrs of age	15-49 Yrs	>50 yrs
Afr	0.12	0.2	9	0.39	0.67	6.23
Amr	0.05	0.15	1.4	0.12	0.56	1.74
Emr	0.08	0.18	6.3	0.08	0.26	2.14
Eur	0.05	0.14	1.1	0.07	0.58	2.09
Sear	0.08	0.18	4.9	0.49	1.76	10.31
Wpr	0.06	0.14	2.7	0.21	1.36	7.81
World				1.36	5.20	30.32

Afr, WHO African region; Amr, WHO Region of the Americas; Emr, WHO Eastern Mediterranean Region; Sear, WHO South-East Asia Region; Wpr, WHO Western Pacific Region

Blindness defined as visual acuity < 3/60 - NLP in the better eye with best correction

South East Asian Region [7]

Region	Total no of children (millions)	Prevalence of blindness in 0-15 yrs age group	Estimates of number of blind children	% Blind children worldwide
China	340	0.050	210,000	15.0
India	350	0.080	270,000	19.3
Other Asia	260	0.083	220,000	15.6

MAGNITUDE OF VISION LOSS DUE TO EYE INJURIES

Prevalence (per 100,000) of Blindness/ Low vision due to eye trauma; Review of 10 Cross-sectional Random sample studies are given below,

Country	Year	Population Examined	Blindness	Low Vision	Monocular loss of vision**
			Due to eye injury		
Congo	1982	7041	-	-	216
The Gambia	1986	8174	14	-	-
Mali	1985	3538	78	137	490
Morocco	1992	8878	10.5	90	392
Nepal	1980	39887	19.2	-	228
Pakistan	1990	5732	75	-	432
Saudi Arabia	1990	4340	46.5	-	407
Togo	1984	2758	39	37	448
Tunisia	1993	8548	17	-	285
Turkey	1989	7497	-	75	315

* Blindness is defined as vision <3/60. Low vision is defined as vision <6/18 but >3/60.
** Includes monocular blindness and monocular low vision.

(Source: WHO/PBL blindness data bank)

MAGNITUDE OF CHILDHOOD EYE TRAUMA

Percentage of childhood eye trauma in studies on eye trauma in patients of all ages (15 studies) are given below:

Authors	Definition of childhood (years)	% of childhood trauma
Moukouri	<20	32
Ilsar	<20	34.6

Olurin	<20	29
Negrel	<15	36
Maltzman	<11	29
Schein	<20	33.5
Koval	<17	47
Khan	<15	43.7
Punnonen	<16	17
Thordarson	<15	37
Lindstsedt	<20	35
Canavan	<16	29.8
Morris	<10	10
Morris	<20	19
Nepal Eye Study	<15	21.7
Fong	<15	6

(Source: WHO/PBL blindness data bank)

IMPACT OF CHILDHOOD BLINDNESS

Studies have shown that blindness is second only to cancer in the degree of dread with which it is regarded. [8]

Definitions

- WHO defines Childhood as the period of life before 15 years of age.
- Visual loss is categorized according to the International Classification of Disease (ICD) [9]

Level of visual impairment	Category of vision	Visual acuity in better eye with optical correction
Slight	Normal vision	6/18 or better (LogMAR 0.4 or better)
Visual impairment (VI)	Low vision	Worse than 6/18 up to 6/60 (LogMAR 0.5to 1.0)
Severe visual impairment (SVI)	Low vision	Worse than 6/60 up to 3/60 (LogMAR 1.1 to 1.3)
Blind (BL)	Blindness	Worse than 3/60 (worse than LogMAR 1.3) to no light perception or visual field< 10 degrees around central fixation

Psychosocial impact

The child undergoes a complex set of feelings after the onset of significant visual impairment: initially rejection, then bargaining, anger, depression, and finally acceptance. The depression stage can sometimes last months or even years.[10]

Visual impairment in a child affects 4 important functional aspects. [11] Orientation/mobility,Communication,Activities of daily life,Sustained near vision tasks. In children with major visual impairments, the development of a positive self-concept is significantly delayed. [12]

Post Traumatic Stress Disorder (PTSD) is a psychological sequel that might develop in the patient as well as in some cases in one or both of parents

after any psychologically distressing event outside the range of usual human experience, including eye trauma in children. [13]

Economic impact

Those blinded during childhood incur a higher economic cost to their family members and society over their lifetime than adults blinded later in life because of more number of man-years lost. [14-15]

The economic burden of blindness in India for the year 1997 was Rs. 159 billion (US$ 4.4 billion), and the cumulative loss over lifetime of the blind is Rs.2,787 billion (US$ 77.4 billion). Childhood blindness accounts for 28.7% of this lifetime loss. [15]

RISK FACTORS

Several factors place children at risk for a serious accidental eye injury [16]

1. Age: Children aged between 0 and 5 years of age are probably at greater risk for serious eye injury than older children because of their relative inexperience, natural curiosity and immature motor skills making them more vulnerable.

2. Anatomically, children's eyes are more forwardly displaced and exposed because of relatively flat features.

3. For obvious reasons, the recognition of ocular injuries is often delayed in children with the added difficulty a child faces in communicating the nature and extent of injuries.

4. Associated presence of malnutrition, vitamin 'A' deficiency, delayed milestones also contribute to the severity of injuries because of a decompensated cornea or blepharitis.

5. The risk of a child with amblyopia sustaining blinding trauma to the normal eye is significantly higher (3 times that of a normal adult and 16 times that of a normal child) than for the general population.[17]

Definition of ocular trauma terms: The Birmingham eye trauma terminology (BETT) [18]

1. Eyewall – Sclera and cornea.
2. Closed globe – The eyewall does not have a full-thickness wound.

3. Open globe – The eyewall has a full-thickness wound with the choroid and retina intact, prolapsed or damaged.

4. Rupture – Full-thickness wound caused by a blunt object by an inside-out mechanism.

5. Laceration – Full-thickness corneal and/or scleral wound caused by a sharp object by an outside-in mechanism.

6. Penetrating injury – Single, full-thickness wound of the eyewall usually caused by a sharp object.

7. Perforating injury – Two full-thickness wounds (entrance and exit) of the eyewall usually caused by a missile.

8. Intraocular foreign body – The retained foreign body causes a single entrance wound.

9. Contusion – Closed globe injury resulting from a blunt object: injury can occur at the site of the injury or at a distant site secondary to changes in globe configuration or momentary intraocular pressure elevation.

10. Lamellar laceration – Closed globe injury of the eyewall or bulbar conjunctiva usually caused by a sharp object; the wound occurs at the impact site.

11. Superficial foreign body – Closed globe injury resulting from a projectile; the foreign body becomes lodged into the conjunctiva and/or eyewall but does not result in a full-thickness eyewall defect.

Proposed ocular injury classification schemes [19]

Open globe injury

Type

A. Rupture

B. Penetrating

C. Intraocular foreign body

D. Perforating

E. Mixed

Closed globe injury

Type

A. Contusion

B. Lamellar laceration

C. Superficial foreign body

D.Mixed

Grade	Visual acuity
1	>6/12
2	6/18 - 6/36
3	6/60 - 2/60
4	1/60 - PL
5	No light perception

Pupil

Positive: Relative afferent pupillary defect present in affected eye

Negative: Relative afferent pupillary defect absent in affected eye

Zone (for open globe injuries)

I : Isolated to cornea (including the corneoscleral limbus)

II : Corneoscleral limbus to a point 5mm posterior into the sclera

III : Posterior to the anterior 5mm of sclera

Zone (for closed globe injuries)

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

II : Anterior segment (involving structures in anterior segment internal to the cornea and including the posterior lens capsule; also includes pars plicata but not pars plana)

III : Posterior segment (all internal structures posterior to the posterior lens capsule)

CAUSES OF CHILDHOOD EYE INJURIES

Causes at various ages [16,20,21]

1. Prenatal period: Contrary to the popular belief, ocular injuries can occur to a foetus in uteri.[22] Ocular injuries have been reported during amniocentesis[23-28] and adnexal injuries during episiotomy, forceps-assisted delivery or with the surgical knife during delivery with caesarean section.[29-32]

2. Infancy and Toddler Period: The most common ocular injury during the early months of life is corneal scratches (abrasions) from their own fingernails, siblings or parents.[33] Another common entity we come across is injury with the metal hook of the mother's blouse while feeding the child resulting in injuries and the bindi (applied on forehead by mother) getting lodged in the fornix causing severe kerato-conjunctivitis. Alkali burns due to lime are very common in India. Also injuries by accidental spill of raw soap nut powder, detergent powder and liquids, hot water or soups are seen invariably resulting in conjunctivitis and at times keratitis. Injuries associated with child abuse, common in western literature is quite rare in our country.

3. Older Children: Young boys are more frequently injured than girls, since they are more active in indoor and outdoor activities.[34] Thorn pricks, sharp injuries from geometry instruments, animal bites (dogs, bird beak) are common. Firecracker injuries are also commonly seen in this age group.

Injuries Common in Our Country

- Gullidanda injury [2,35]
- Injury from chuna packets [36]
- Broom stick injuries [37]

CLINICAL MANIFESTATIONS

Mechanical - Closed Globe Injuries [39,40]

A. Blunt injuries

1. Lesions of the conjunctiva

- Haemorrhage, oedema, chemosis
- Bruising & lacerations

2. Lesions of the Cornea

- Oedematous and haemorrhagic changes
    i. Epithelial opacities and erosions
    ii. Blood staining of the cornea
    iii. Folding of Bowman's or Descemet's membrane.
- Pigment deposits
- Corneal lacerations:
    i. Partial thickness lacerations
    ii. Tears in Descemet's membrane
    iii. Complete rupture of cornea

3. Lesions of the Iris & Ciliary body

- Changes in pupil and accommodation
    i. Traumatic miosis and accommodative spasm
    ii. Traumatic iridoplegia and cycloplegia
- Vascular changes
    i. Reactive hyperaemia and exudation
    ii. Haemorrhage
        - Into the tissue of iris and ciliary body
        - Traumatic hyphema

- Lacerations of the iris and ciliary body
    i. Tears at the pupillary border, sphincter tears
    ii. Tears in the iris stroma
    iii. Dehiscences of the pigmentary layer
    iv. Iridodialysis
    v. Irideremia (traumatic aniridia)
    vi. Iridoschisis
    vii. Traumatic cyclodialysis
    viii. Retroflexion of the iris
- Inflammatory and atrophic changes
    i. Traumatic iridocyclitis
    ii. Post traumatic atrophy of the iris and ciliary body
    iii. Acute necrosis of the iris and ciliary body
    iv. Pigmentary changes (traumatic heterochromia)

4. Lesions of the Lens and Zonules
    - Lenticular opacities
        i. Vossius's ring opacity
        ii. Discrete subepithelial opacities
        iii. Traumatic rosette shaped opacities
        iv. Traumatic zonular cataract
        v. Diffuse concussion cataract
    - Subluxation & dislocation of the lens
5. Lesions of the Choroid
    - Vascular changes
        i. Choroidal hemorrhage
        ii. Choroidal detachment

- Choroidal lacerations
- Traumatic choroiditis

6. Lesions of the retina
   - Edematous and atrophic changes
     i. Concussion edema, necrosis
     ii. Concussion changes at the macula
        - Macular edema
        - Macular cysts & holes
        - Traumatic atrophy of Haab
        - Acute concussion necrosis
     iii. Peripheral atrophic retinal changes
   - Vascular changes in retina
     i. Traumatic haemorrhages
     ii. Embolism & thrombosis
     iii. Traumatic aneurysm
   - Retinal tears
   - Traumatic retinal detachment

7. Lesions of the Optic disc
   - Papillitis and atrophy
   - Rupture and avulsion of the nerve

8. Effects on the Vitreous
   - Vitreous liquefaction/ opacification/ detachment/ herniation
   - Vitreous hemorrhages

9. Rupture of the Sclera

10. Changes in Refraction
    - Traumatic hypermetropia
    - Traumatic myopia

11. Changes in the Ocular tension

- Traumatic instability of the tension
- Traumatic glaucoma
- Traumatic hypotony

B. Incised wounds

- Corneal abrasions
- Recurrent corneal erosions
- Deep non-perforating corneal wounds
- Wounds of the conjunctiva
- Wounds of the sclera

C. Concussion & Contusions of the ocular adnexa

1. Contusions of the Lids
    - Edema & hemorrhage of the lids
2. Fractures of the orbit
3. Orbital hemorrhages
4. Orbital emphysema
5. Contusion injuries to orbital contents
    - Changes in the position of the eyeball
        i. Luxation of the globe
        ii. Traumatic enophthalmos
    - Concussion injuries to the orbital muscles & nerves
    - Traumatic aneurysm of the ophthalmic artery
    - Serous tendonitis

6. Injuries to the lacrimal apparatus

Mechanical - Open Globe Injuries [39]

1. Conjunctiva - Tiny defects, localized areas of chemosis, subconjunctival haemorrhage pigmentation, and presence of subconjunctival foreign body, any of these can indicate a possible ocular penetration

2. Cornea
- Incised wound
- Lacerations with or without loss of corneal tissue

3. Iris
- Iridodialysis
- Sphincter tear
- Holes
- Foreign body hidden in iris crypts
- Prolapse through the site of perforation and possible loss of uveal tissue.

4. Anterior chamber - Presence of small foreign body angle

5. Lens
- Defect in lens capsule
- Intralenticular foreign bodies and opacities
- Localised cataract
- Subluxation
- Dislocation

6. Posterior segment
- Vitreous haemorrhage
- Posterior scleral rupture
- Vitreous opacities
- Retained IOFB
- Retained tears, lacerations and detachment
- Retinal haemorrhage
- Choroidal laceration, perforation
- Expulsive choroidal haemorrhage

7. Optic nerve - Partial or complete transection by intruding object

Chemical Injuries [41- 49]

Chemical injuries are potentially devastating ocular surface injuries that may result in permanent visual impairment. The majority are accidental.[42] Alkali burns are twice as common as acid burns since alkalis are more widely used at home and in industry. [42]

The most common involved alkalis are ammonia, sodium hydroxide and lime. One of the most common chemical injuries is caused by chuna packets (sodium hydroxide), which has been described in the previous section. Ammonia being a household cleaner, is also easily accessible to children, because it is usually stored in a cabinet beneath the sink or on a low shelf.

The commonest acids are sulphuric, acetic, chromic and hydrochloric.[47] These acids can be found in various cleaning agents, rust removers, automobile batteries and other products.

The severity of a chemical injury is related to the properties of the chemical, the area of affected ocular surface, duration of exposure (retention of particulate chemical on the surface of the globe) and related effects such as thermal damage. Alkalis tend to penetrate deeper than acids, which coagulate surface proteins, resulting in a protective barrier. Ammonia and sodium hydroxide may produce severe damage due to rapid penetration.

Thermal Injuries[50-61]

Flame, flash and chemical burns account for most oculopalpebral burns.[50] Common agents are fireworks, hot liquids, head of a lighted match and open coal fire. Fireworks remain a major source of preventable mechanical and thermal injury in children.[51] The eye is one of the most commonly involved organs in fireworks related injuries.[52,53] Fireworks are a worldwide menace, as evidenced by reports from a wide variety of countries. [54-60]

EVALUATION

Emergency room evaluation of trauma affecting lids, eye or orbit [62-65]

Any life threatening injury should be treated first.

1. A quick history should be obtained : time and mode of injury; nature of injuring object; prior treatment received; time lag between injury and treatment; past medical and ocular history; tetanus immunization; allergies.

2. First aid should be rendered in cases of true emergency (e.g., chemical burns of the cornea)

3. Visual acuity should be determined whenever possible. This is important for medical and legal reasons. The method used to measure acuity must be geared to the age and level of cooperation of the child.

4. Spectacles, if any, should be inspected (glass/ plastic)

5. Haemorrhages and infections of orbit, lid or conjunctiva should be noted. Orbital rim should be palpated (discontinuity/ crepitus); facial and corneal sensations should be checked.

6. Any real or apparent displacement of globe should be appraised: anterior, posterior or vertical.

7. Pupillary shape, size and reactions should be recorded. Some of the steps mentioned below might require sedation or anaesthesia

8. Partially and completely penetrating injuries of cornea and sclera should be differentiated. Lid retractors may be used. Orbicularis muscle may be anaesthetised if squeezing prevents atraumatic examination of the eyeball. Uveal, vitreal, or lenticular prolapse should be noted., where possible, Siedel test should be done in all cases of penetrating injuries.

9. Depth of all lid lacerations should be investigated, noting fat in wound. Foreign bodies under the lid should be sought: lid should be everted & fornices swept with cotton swab after use of topical anaesthetic.

10. Cornea should be examined for opacities, ulcers, foreign bodies, rust rings, and abrasions, using fluorescein when required.

11. Anterior chamber should be examined for hyphema. Gonioscopy should be done to rule out angle recession. Iridodonesis and iridodialysis should be noted.

12. Dislocation/ subluxation of lens & presence of cataract should be noted.

13. If traumatized globe is intact and cornea is undamaged, intraocular pressure should be measured, at least digitally and preferably with tonometer.

14. Fundus examination using direct and indirect ophthalmoscope without indentation: appearance of optic nerve head, macula, retinal circulation and intraocular haemorrhage, presence of foreign bodies should be noted. Search for retinal tears and disinsertions.

15.If diplopia is present, analysis of ocular ductions and versions; forced-duction test under topical anaesthesia should be done.

16. X-rays should be obtained in all cases of possible retained foreign body in globe or orbit and whenever orbital fracture is conceivable.

17. Consider value of photographing all injuries.

MANAGEMENT

Lid ecchymosis

After ruling out underlying severe globe injury, cold compresses for the initial 24-hour period, followed by warm compresses as needed.

Lid lacerations [66]

- Primary edge-to-edge closure in layers.
    - Tarsoconjunctival layer – 6-0 Vicryl
    - Muscle-fascial layer – 6-0 vicryl
    - Skin – 6-0 Silk

- With minimal tissue loss – primary closure with lateral cantholysis
- With extensive tissue loss – may require major reconstructive procedures
- Canalicular lacerations – use of stents and end-to-end reapproximation of torn canaliculi.

Traumatic ptosis [67]

Surgical repair of torn Levator muscle/aponeurosis after oedema has subsided, but before onset of fibrosis.

Blow-out fracture [68]

Initial conservative management until edema subsides. Surgical repair, if required using synthetic material such as Supramid, silicone or Teflon.

Corneal abrasions [69,70]

Conservative Management: An antibiotic eye ointment with firm patch usually suffices.

Penetrating corneal wounds

Careful corneal wound closure to achieve a water tight globe with minimal scarring and astigmatism should be the aim.[71] 10-0 interrupted nylon sutures are used. Any opaque tissue in the visual axis must be removed promptly to prevent amblyopia in children, improve vision and prevent chronic inflammation & scar tissue formation. Cyanoacrylate tissue adhesive can be used to close some small

corneal lacerations or minute leak after surgical repair.[72] Severe damage to cornea might need penetrating keratoplasty.[73,74]

Corneal laceration with iris incarceration

Devitalized & extremely macerated tissue and feathered or depigmented iris should be excised. It Is safer to abscise tissue which has remained prolapsed for more than 24 hours. After adequate iris repositioning, the corneal wound is sutured.

Traumatic iridodialysis

A traumatic iridodialysis should be repaired when it is large enough to cause multiplopia or glare.[75,76] It is repaired by one or more mattress sutures of double-armed 10-0 propylene sutures tied externally under a scleral flap.[77]

Corneal laceration with lens involvement [78]

Situations in which primary lens removal is indicated:

a. A lens with disrupted capsule & flocculent cortical matter in anterior chamber.
b. A lens & vitreous mixture.
c. A clearly cataractous lens.

Corneal laceration with vitreous involvement [79]

The primary goal is to relieve vitreous incarceration in the wound. After closure of wound, disrupted vitreous in the anterior chamber can be removed by vitrectomy through limbal approach.

Corneo-scleral lacerations with or without uveal and vitreous prolapse[80,81]

Lacerations extending beyond the limbus and into the sclera should be explored to determine their full extent. The wound is closed by zippering technique. It is closed from anterior(limbal) end with interrupted sutures placed successively proceeding posteriorly.

Hyphema [82-95]

- Supportive – Bed rest with patching may decrease rebleeding. [87,88]
- Medical – Miotics, salicylates,[89-91] cycloplegics,[92] antifibrinoloytics,[93] fibrinolytics, estrogens and corticosteroids[94] have been suggested.
- Surgical

Traumatic cataract following blunt injury [96]

No initial treatment is required if the capsule is intact. If capsule is ruptured, atropine and a steroid should be used topically to control uveitis. Extra capsular extraction is possible in most cases in older patients, but aspiration is commonly done for patients below the age of 20 years. Implantation of intraocular lens, as a primary or a secondary procedure, as suitable.[97]

Traumatic retinal dialysis [98,99]

Surgical management can be in the form of scleral flaps, cryotherapy, diathermy or a silicone implant, with or without encircling element. Subretinal fluid drainage is required in most cases.

Traumatic retinal detachment [100-102]

Conventional scleral buckling, with or without pars plana vitrectomy, as suitable, has relatively good prognosis in detachments caused by ocular contusions but poorer prognosis in those caused by penetrating injuries.

Management of chemical injuries

Emergency management

A chemical injury is the only eye injury that requires immediate treatment without first taking a history and performing a detailed examination.

1. Copious irrigation [103-104] – crucial to minimize the duration of contact with the chemical and to normalize the pH in the conjunctival sac as soon as possible. Normal saline (or equivalent) [105] is used to irrigate the eye until pH is normalized. Double eversion of lids to remove any retained particulate.
2. Debridement – of necrotic areas of corneal epithelium should be performed to facilitate re-epithelialisation.

Grading of severity

- Hughes-Roper-Hall classification of chemical burns [106-108]

  Grade I: Clear cornea and no limbal ischemia (excellent prognosis)

  Grade II: Hazy cornea but with visible iris details and less than one-third (120 ^{o}) of limbal ischemia (good prognosis)

  Grade III: Total loss of corneal epithelium, stromal haze obscuring iris details and one-third to half (120 ^{o} – 180 ^{o}) of limbal ischemia (guarded prognosis)

  Grade IV: Opaque cornea and more than half (>180 ^{o}) of limbal ischemia (very poor prognosis)

- Other features to be noted at initial assessment are the extent of corneal and conjunctival epithelial loss, iris changes, status of the lens and intraocular pressure.

Medical treatment

1. Steroids – reduce inflammation and neutrophil infiltration. Should be tailed off after 7-10 days as they impair stromal healing. [109]
2. Ascorbic acid – improves wound healing by promoting collagen synthesis.
3. Citric acid – reduces the intensity of inflammation by inhibiting neutrophil activity.
4. Tetracyclines in the dose of 100mg OD – reduce inflammation and ulceration.

Surgery [110]

1. Early surgery – may be necessary to revascularise the limbus, restore the limbal cell population and re-establish the fornices.

- Advancement of Tenon capsule
- Limbal stem cell transplantation [111]
- Amniotic membrane grafting [112]

2. Late surgery -

- Division of conjunctival bands and symblepharon
- Conjunctival or mucous membrane grafts
- Correction of eyelid deformities
- Keratoplasty – should be delayed for at least 6 months
- Keratoprosthesis – may be required in very severely damaged eyes

PROGNOSIS IN CHILDHOOD EYE INJURIES

Prognosis in eye injuries in children is debated.[113] Without doubt, anterior lacerations carry a better prognosis than posterior lacerations. But in young children, with the risk of amblyopia, the prognosis may not be so good, even with anterior lacerations. When anterior lacerations are combined with cataract, the prognosis worsens.[114]

Several factors have been found to correlate with an unfavourable visual outcome:[115]

i. Initial presenting visual acuity worse than 5/200 (1/60)
ii. Open globe injuries caused by blunt trauma
iii. Penetrating wounds involving the sclera
iv. Double penetrating (perforating) eye injuries
v. Dense vitreous haemorrhage

PREVENTION OF EYE INJURIES IN CHILDREN[116]

Everyone in the community may play a part by showing concern for the well-being of others. Children are often victims of trauma, not only because of their innocence, but also because of the lack of supervision by their elders. However, they too may play their part in making each other aware of unsafe activities and avoid confrontational games. Adults have a larger role to play in health promotion and accident prevention. Teachers have opportunity to schedule health education activities in school. Parents and teachers should also be aware of any situation, which presents opportunity for physical danger. The use of traditional eye medicines has also resulted in varying degrees of damage to the eyes. Not all traditional practice is harmful, but people must be made aware of proven harmful agents.

REVIEW OF LITERATURE

Important studies on Epidemiology of Eye Injuries in Children relevant to our study are summarized below in chronological order:

1. Eye injuries in children. M Niiranen and I Raivio. Br J Ophthalmol. 1981 Jun; 65(6): 436-8 [117]

This was a retrospective study of children's eye injuries treated during 1977 at Helsinki University Eye Hospital. There were 110 cases representing 34.5% of all eye injuries and 3% of all patients treated in 1977; 81.8% were boys and 18.2% girls. Half of the injuries were caused by another child, one-third were self-inflicted, and the rest were other accidents. The risk of eye injury in girls was low and stable at all ages, but in boys the risk grew markedly at the age of 8 years. The commonest cause of injury was a thrown missile. Other important causes were shots, hits, and sports accidents. Two-thirds of the injuries were concussions. The proportion of perforation was 8.9%, which is a much lower figure than in earlier reports, suggesting that the injuries have become milder. Some kind of complication was seen in 16% of concussions. No secondary bleeding was found among them. Permanent impairment of vision

was seen in 2 cases: one had a visual acuity of 0.1 because of traumatic cataract and the other 0.6 because of corneal scars. Although the number of perforations was too low for statistical analysis, the final result in this group suggested that the prognosis of perforating eye injury was still bad.

2. Penetrating ocular injuries in young patients: Initial Injuries and Visual Results. Sternberg Paul JR et al. Retina. 4(1): 5-8, Winter/ Spring 1984 [115]

The records of 197 patients aged 18 years or younger who underwent primary repair of a penetrating ocular injury at the Wilmer Ophthalmological Institute from January 1970 through December 1981 were reviewed. The injury was caused by sharp objects in 49% of cases, missiles in 35%, and blunt trauma in 14%. Of 159 patients with at least 6 months follow-up, 110 (69%) achieved final vision of 5/200 or better, and 77 patients (48%) achieved final visual acuity of 20/50 or better. The prognosis after a penetrating injury is strongly influenced by the nature of the injury and the extent of initial damage.

3. Epidemiological study of eye injuries in Brazilian children. C. A. Moreira Jr, M. Debert-Ribeiro and R. Belfort Jr. Arch Ophthalmol 1988 Jun Vol 106: 781-784 [118]

This was a year-long follow-up study of 146 eye injuries in children up to 15 years of age. This was carried out in two emergency hospitals of a southern Brazilian city. These injuries represented approximately 65% of the total number of patients seeking ophthalmic care at emergency hospitals within this city. Patients were followed up for at least four months after injury; visual results as well as epidemiological factors were analyzed. Based on these findings, children in the 0- to 5-year-old group were at greatest risk, regardless of sex; among children older than 5 years, eye injuries were more frequent in boys. Generally, the child took part in the accident as an active participant, and adequate adult supervision decreased the number of these accidents.

4. Eye injuries in children in Israel. A nationwide collaborative study.

Rapoport I et al, Arch Ophthalmol. Vol. 108 No.3, March 1990 [119]

A nationwide prospective collaborative study on ocular trauma was performed in Israel during a period of 3 years (1981 through 1983). Almost half of the traumas (1127 [47%] of 2416 eyes) were sustained by children younger than age 17 years, and mainly between the ages of 6 and 12 years. Most of the injuries happened at home (38.1%) or in the street (26.8%) and during play and sport (65.1%). The male-to-female ratio among the children was 4:1. Blunt

injuries accounted for 59.2%; 30.5% were perforating injuries and the rest were chemical and radiation injuries.

5. Causes of paediatric eye injuries: A population-based study.

E. Strahlman, M. Elman, E. Daub and S. Baker. Archives of ophthalmology Vol 108, No 4,April 1990 [120]

A population-based study of eye injuries requiring hospital admission for children younger than 16 years was conducted in the state of Maryland during the 1982 calendar year. The population-based estimate of the incidence of ocular trauma in Maryland children was 15.2 per 100,000 per year (95% confidence interval, 12.8 to 17.7). Male patients outnumbered female patients as victims of eye injuries by a ratio of approximately 4:1; eye injuries in 11- to 15-year-old children occurred at more than twice the rate than for younger children. The most common cause of pediatric ocular trauma was accidental blows and falls (37%). Sports and recreational activities accounted for 27% of all eye injuries, 39% of all non-penetrating injuries, and 40% of all injuries in 11- to 15-year-old children.

6. Etiology of pediatric perforating eye injuries in Southern Turkey. Merih Soylu, Nihal Demircan, Müslime Yalaz,Ismail Isigüzel. Ophthalmic Epidemiology. Vol 5, Issue 1 March 1998,7-12 [121]

In this study, the records of 242 children, aged 1-14 years, admitted with perforating ocular injury were reviewed retrospectively over a 5-year period. There were 175 boys and 67 girls in the study group. The patients were divided into 3 groups according to their ages. Perforating injuries occurred most frequently in the street in all groups. The second most common place of the injury was at home in the 1-9 year-olds and in the fields in the 10-14 year-olds. The cause of the perforation was a metallic substance in 32.6%, wood in 15.3%, stone in 12.0%, glass in 12.3%, pellets in 12%, and injection needles in 8.3%. Most of the perforations occurred during unsupervised play, while all perforations with glass occurred during traffic accidents. Surgery was performed in 234 patients, while 8 patients in whom spontaneous closure had already occurred during admission received only medical treatment. In 28.9% the visual acuity was undetermined, in 25.7% the visual acuity was 0.1 or more, in 22.7% the visual acuity was between 0.06 and light perception, and in 22.7% there was no light perception on final evaluation.

7. Childhood eye injuries in North Jordan. Muawyah D. Al-Bdour and Mohammed A. Azab. International Ophthalmology. Vol 22, No 5, Sep 1998 [122]

In this study, records were reviewed of 116 children who sustained serious eye injuries that required admission to Princess Basma Teaching Hospital between October 1995 and November 1998. The material was analyzed retrospectively with respect to various epidemiological features.

71.5% of the injured children were male and 28.5% were female. There was a marked preponderance of injuries in the age group 6–10 years. The majority of injuries occurred during play and sport (74.1%). Stones and sharp objects were the most common causes accounting for 18.1% and 17.2% respectively. Most of the sharp objects were household instruments. Perforating injuries were more common than non-perforating injuries. 56% of injured eyes had a low vision with visual acuity between 6/24 and 3/60, and 13% had a blinding outcome with visual acuity less than 3/60.

8. Eye injuries in children: The current picture. Caroline J MacEwen, Paul S Baines, Parul Desai. Br J Ophthalmol August 1999; 83:933-936[123]

This was a prospective observational study of all children admitted to hospital with ocular trauma in Scotland over a 1 year period. The commonest mechanism of injury was blunt trauma, accounting for 65% of the total. 60% of the patients were admitted with a hyphema. Injuries necessitating admission occurred most frequently at home (51%). Sporting activities were the

commonest cause of injury in the 5-14 age group. There were no injuries caused by road traffic accidents or fireworks. Patients were admitted to hospital for a mean of 4.2 days (range 1-25 days). One (1%) child had an acuity in the "visually impaired" range (6/18-6/60) and one (1%) was "blind" (6/60) in the affected eye. No child was bilaterally blinded by injury and none required blind or partial sight registration.

9. Loss of visual acuity due to eye injuries among 6292 school children in the Sultanate of Oman. Joan Lithander et al. Acta Ophthalmol. Scand. 1999: 77: 697–699 [124]

In 1992–94 a nation-wide survey in primary schools in the Sultanate of Oman for ocular disorders was conducted. A random selection of 6292 children from Grades 1 and 6 from all primary schools in the country provided the research sample. Children who failed the visual acuity screening test received a complete ‘‘on the spot’’ eye examination by the pediatric ophthalmologist. 12 children were found to have monocular low vision (VA °0.3 to amaurosis) caused by injury. Total prevalence for loss of vision in one eye was 0.19%, with 0.15% in 6-year-olds and 0.25% in 12-year-olds. Traumatic cataracts were noted in 4 children, 3 of these were in need of surgery. One child had aphakia

after trauma surgery and needed a secondary lens implant. Altogether the prevalence of traumatic monocular visual damage in this study was 0.19%.

10. The aetiology of perforating ocular injuries in children. C G Thompson, N Kumar, F A Billson and F Martin. Br J Ophthalmol 2002;86:920-922 [125]

All cases of perforating ocular injury presenting to a single paediatric hospital (age less than 16 years) over a 17 year period were identified by a medical record search A total of 72 cases were identified. The commonest causes of perforating ocular injury were sharp tools (knives/scissors) poked by the child into his/her own eye (17%), or objects thrown at the child (17%). Injuries were most likely to have occurred at home (58%). The age range for injuries was 8 months to 14 years 8 months. Perforating ocular injury was most frequent in the 3–6 year group (32%) followed by the 6–9 year group (25%). Males were more frequently involved than females . There was no correlation between the laterality of the eye, the time of day of the occurrence, or the day of the week of the occurrence. The final acuity achieved was better or equal to 6/12 in 36% and less than 6/60 in 31%. Injuries occurred more frequently on weekends than on weekdays. There were 6 enucleations (8%). Follow up was for an average period of 25 months.

11. Mechanical eye (globe) injuries in children. Andrew Vasnaik et al. Journal of Pediatric Ophthalmology and Strabismus. 2002; 39:5-10 [126]

In this study, the in-patient records of children who were admitted with mechanical eye (globe) injuries were reviewed. Of the 68 children, the mode of injury was child related in 12(17.7%) patients, agent related in 40(58.8%) patients & environment related in 22(23.5%) patients. Mild injuries were seen in 22(32.4%) patients, moderate in 31 (45.6%) and 15(22.1%) had severe injuries. None of the patients with host-related injuries had a severe injury. 6(66.67%) patients with host-related injuries had a good visual outcome and none had a poor outcome.

12. Severe ocular injuries in Greek children. Ephigenia K. Mela; Constantinos D. Georgakopoulos; Athanasios Georgalis; John X. Koliopoulos; Sotirios P. Gartaganis Ophthalmic Epidemiology, Volume 10, Issue 1 February 2003, 23 - 29 [127]

This was a retrospective analysis of 95 cases (103 eyes) of eye injuries in children younger than 17 years of age admitted to the Department of Ophthalmology, University Hospital of Patras, Greece, during a five-year period. The data were analyzed with respect to age, sex, type, cause and mode

of injury, method of management, duration of hospitalization and final visual deficit. The average age was 9.8 years and males were involved 80% of the cases. The most common type of eye injury was mechanical closed-globe injury (71.8%). Mechanical open-globe injuries were found in 21.3% of the eyes, while burns comprised 6.7% of the injuries. Most injuries were agent-related, with blows and falls being responsible most often. Multiple operations were part of the treatment in 11.6% of the eyes; 14.5% of the eyes were blinded and 15.5% had significant final visual acuity loss.

13. Epidemiology of Childhood Ocular Trauma in a Northeastern Colombian Region. Juan C Serrano, Patricia Chalela, Juan D Arias. Arch Ophthalmol 2003; 121:1439-45. [128]

In this study, the medical records of children 15 years and younger, who underwent evaluation in the emergency department of a tertiary referral center in north-eastern Colombia, during a 5-year period, were reviewed. Records of 393 children with 415 incidents of eye injury were included in the study, of whom 22 were initially treated for bilateral ocular trauma. In this study most patients (64.9%) were boys. The highest proportion of injuries (44.4%) occurred at home, followed by streets and roads (28.6%). Blunt (35.1%) and sharp (22.6%) objects represented the most frequent causes of trauma. Closed-globe

injuries were far more frequent than open-globe injuries for boys (82.4% vs. 17.6%) and girls (83.8% vs. 16.2%). Of those with closed-globe injuries, 253 injuries (80.0%) registered an initial visual acuity of greater than 20/60, whereas 31 open-globe injuries (52.5%) registered an initial visual acuity of less than 20/400. Most closed-globe injuries (223 [92.1%]) did not cause any final visual impairment in the affected eye, whereas 26 open-globe injuries (55.3%) caused severe visual impairment or blindness.

14. Ocular injuries in children aged 0-15 years: epidemiology and clinical aspects at the Bangui National Teaching Hospital. Yaya G et al. J Fr Ophthal. 2005 Sep;28(7):708-12 [129]

A prospective study was conducted on 194 cases in the ophthalmology department over a period of 3 years, and included children aged 0-15 years. A total of 197 eyes were examined by the same practitioner, comprising 191 unilateral ocular injuries and three bilateral injuries. Of the children examined, 59% were males and 41% were females, with a sex ratio of 1.3. The age group with the highest exposure (39.3%) was between 5 and 10 years. Punishments (25.9%), accidents during games (19.3%) and fights (18.8%) were the main sources of these ocular injuries. Consultation most often occurred long after the incident. Only 2.0% were seen before the 6th hour and 43.7% between 48 hours and 1 week. The clinical picture was dominated by bruises posing a therapeutic

problem: 25 hyphemas (12.7%), 19 conjunctival injuries (9.6%), 19 lens dislocations with or without vitreous loss (9.6%), 18 trauma-induced cataracts (9.4%), and 15 eye lid injuries with or without lachrymal duct ruptures (7.6%). The most serious injuries were cornea injuries with or without hernia of the iris (19.8%) and nine globe dislocations (4.5%)

15. Perforating ocular injuries in children: a retrospective study of 57 cases. Beby F, Kodjikian L, Roche O, Donate D, Kouassi N, Burillon C, Denis P. J Fr Ophtalmol. 2006 Jan; 29(1): 20-3 [130]

The hospital records of 57 patients under 14 years of age who were treated for open globe injuries at Edouard Herriot Hospital, Lyon, France, between January 1999 and December 2003 were reviewed. In total they reviewed 57 patients: 41 males and 16 females. The mean age at admission was 6.8 +/- 3.5 years. The injury involved the right eye in 27 cases and the left eye in 30 cases. Sharp or pointed objects accounted for the majority of injuries. The most common location for a perforating ocular injury to occur was at home. Wounds involved the cornea in 41 cases. There was iris hernia in 21 cases, hyphema in 15 cases, vitreous prolapse in 14 cases, lens damage in 12 cases, and shallow anterior chamber in 11 cases. The most frequent complication was traumatic cataract. Secondary lens removal was performed in 15 cases. Visual

acuity was 0.5 or better in 27 of the 57 eyes, with a mean follow-up period of 12 months.

16. Pediatric eye injury-related hospitalizations in the United States.

Brophy M, Sinclair SA, Hostetler SG, Xiang H. Pediatrics. 2006 Jun; 117(6): e1263-71 [6]

This study aimed to study the demographic, medical care, and financial characteristics associated with major categories of pediatric eye injury.

Cross-sectional data were derived from pediatric inpatient Database of the Healthcare Cost and Utilization Project for the year 2000.

These records represented an estimated 7527 eye injury-related hospitalizations among children aged 20 years or less in the United States during the year 2000. Inpatient charges for the treatment of these injuries were more than $88 million. The rate of hospitalization for pediatric eye injuries in the United States in 2000 was 8.9 per 100,000 persons aged 20 years or less. Young adults aged 18 to 20 years accounted for the highest percentage of hospitalizations (23.7%). Males accounted for 69.7% of hospitalizations. A majority of hospitalizations were for open wounds of the ocular adnexa. Motor vehicle crash was the most common cause of injury, followed by being struck

by or against an object and being cut or pierced.

These findings illustrated the need for eye injury prevention efforts, like educating parents and children about the potential for eye injuries at home and in dangerous situations.

17. Penetrating eye injuries in South African children: aetiology and visual outcome. Grieshaber MC, Stegmann R. Eye 2006, Jul;20(7):789-95 [131]

In this study,100 consecutive patients, aged 16 years and under, with penetrating ocular injuries undergoing surgery were prospectively evaluated. Most children (66%) were injured during play. In all, 55% of penetrating eye injuries occurred at home, and all injuries to children under the age of 6 years occurred there. Most injuries occurred in the absence of a caregiver (85%). Sticks, wire, and glass caused half of all injuries (48%). The most common mechanism of injury was impact with a sharp object (46%). Only 25% of injured presented to the hospital within 24 h of injury; the more severe the sustained injury and the younger the patient, the earlier was attendance at the clinic. Most patients (71%) regained best-corrected visual acuity (Snellen equivalent) of 20/200 or better, and 51% regained 20/40 or better. Patient age and delay of presentation were not of prognostic value.

18. Severe Ocular Injury Resulting from Chuna Packets. Tushar Agarwal, Rasik B. Vajpayee, Namrata Sharma, Radhika Tandon. Ophthalmology 2006; 113:960–961 [36]

This was a retrospective study of 21 patients (25 eyes) who experienced ocular burns as a result of bursting of chuna packets. The average age at time of injury was found to be 8.4-5.5 years. The median visual acuity at presentation was light perception with projection. The ocular burns were grade 4 in 23 eyes. Eight of 25 eyes were treated medically, and the rest underwent 1 or more surgeries in the form of symblepharon release (n=6), amniotic membrane grafting (n =3), allograft or autograft stem cell transplantation (n =6), and large diameter lamellar keratoplasty (n =6). At the final follow-up (mean 637-592 days), median visual acuity was 1/60.

AIMS AND OBJECTIVES

Following were the aims and objectives of this prospective study conducted at Aravind Eye Hospital, Madurai between 1st June 2010 and 30th November 2010

1. To determine the risk factors associated with eye injuries in children.
2. To study the different agents involved.
3. To analyze the visual outcome following eye injuries in children.
4. To study the effects of prompt and delayed treatment of these cases
5. To study the effect of educational and social status of the parents on incidence and outcome of eye injuries in children.

MATERIALS AND METHODS

- STUDY DESIGN:

  Ours was a 6 month prospective study of all children with injury to the eye, presenting at Aravind Eye Hospital, Madurai between 1st June 2010 and 30th November 2010.

- INCLUSION CRITERIA:

  1. Patients 0 – 15 yrs of age
  2. Patients with definite history of trauma to the eye
  3. Minimum follow up of 2 weeks

- EXCLUSION CRITERIA:

  1. Adult patients
  2. Doubtful history of trauma
  3. Unlikely to follow up (at least for one visit)
  4. Earlier trauma in the same eye

- STUDY PLAN:

- For the purpose of this study children 15yrs of age or less were considered as “pediatric age group”.
- A detailed history focusing on circumstances of the trauma was obtained from parents or caretakers of each child according to a standardized form; this was followed by a detailed ophthalmic examination.

- All patients were followed up till 30th November 2010 or the most recent follow up before that, follow up had to be of at least 2 weeks.
- The type of injury was recorded according to the Birmingham Eye Trauma Terminology (BETT) [18] which has been described in detail in the section on "Classification of ocular trauma," of this study.
- Visual acuity with pinhole at the time of presentation was recorded whenever possible with reference to patient's age and co-operation during the examination.
- Final visual acuity was defined as the most recently recorded, best corrected visual acuity (Snellen equivalent) of patients either discharged from follow up, or the most recent follow up as on 30th November 2010.
- Children were classified in three age groups:
    - Pre school age 0 – 5yrs; Primary school age 6 – 10yrs and secondary school age, 11 – 15yrs.
- Particular attention was paid to the history to determine the cause, mechanism, locale of occurrence, presence and level of attention of an adult at the time of trauma, and delay in seeking medical help. We further investigated whether these factors were associated with a favourable or unfavourable outcome.
- During examination, the patients found to be requiring surgical intervention, were immediately taken up for wound exploration or repair

under general anaesthesia, while medical therapy was instituted to the rest of the patients. Patients with severe injuries, requiring close monitoring were kept admitted.

- Patients suspected to have endophthalmitis, and patients, in whom posterior segment could not be evaluated due to hazy view, were examined by vitreo-retina consultants and B-scan ultrasonography was done whenever required. These cases were managed appropriately as per the standard of case.

OBSERVATION AND RESULTS

(Values in parenthesis are percentages)

Table 1. Age group distribution

Age Group	Gender		Total
	Male	Female	
0 – 5 Yrs	10 (10.5)	9 (9.5)	19 (20.0)
6 – 10 Yrs	42 (44.2)	9 (9.5)	51 (53.7)
11 – 15 Yrs	23 (24.2)	2 (2.1)	25 (26.3)
Total	75 (78.9)	20 (21.1)	95 (100.0)

The minimum age was 3 years and the maximum was 15 years. The mean age of injured patient was 8.5 years. 20% were in the age group 0-5 yrs, 53.7% were in the age group 6-10 yrs and 26.3% in 11-15 yrs. 78.9% were boys and 21.1% of the patients were girls.

Table 2. Laterality

Age Group	Laterality			Total
	RE	LE	BE	
0 – 5 Yrs	7 (7.4)	10 (10.5)	2 (2.1)	19 (20.0)
6 – 10 Yrs	30 (31.6)	18 (18.9)	3 (3.2)	51 (53.7)
11 – 15 Yrs	15 (15.8)	9 (9.5)	1 (1.1)	25 (26.3)
Total	52 (54.7)	37 (38.9)	6 (6.3)	95 (100.0)

Majority of the patients had unilateral injury except 6 who had bilateral injury. Injury was slightly more common in right eye than left eye.

Table 3. Domicile

Domicile	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Urban	1	2	4	-	3	1	11 (11.6)
Semi Urban	2	3	17	3	9	1	35 (36.8)
Rural	7	4	21	6	11	-	49 (51.6)
Total	10	9	42	9	23	2	95 (100.0)

Half of our patients (51.6%) came from rural areas.

Table 4. Mode of Ocular Injury

Mode of Injury	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Mechanical	7	6	35	8	19	2	77 (81.1)
Chemical	-	2	1	-	-	-	3 (3.1)
Thermal	3	1	6	1	4	-	15 (15.8)
Total	10	9	42	9	23	2	95 (100.0)

Majority of the injuries were mechanical(81.1%).

All 15 cases of thermal injuries were due to firecracker related injuries.

Table 5. Ocular Injury

Ocular Injury	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Contusion	4	3	15	3	7	1	33 (34.7)
Non Penetrating laceration	2	1	7	4	2	-	16 (16.8)
Penetrating Injuries	1	2	10	2	8	-	23 (24.2)
Intraocular Foreign body	-	-	2	-	-	1	3 (3.1)
Scleral perforation	-	-	-	-	1	-	1 (1.1)
Chemical burns	-	2	-	-	-	-	2 (2.1)
Rupture globe	-	-	-	-	1	-	1 (1.1)
Others	3	1	8	-	4	-	16 (16.8)
Total	10	9	42	9	23	2	95 (100.0)

The above table shows details of the number of open and closed globe injurieswith subclassification

Table 6. Object of Injury

Object of Injury	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Stone /Glass	1	1	5	2	3	-	12 (12.6)
Metal piece or Fragment	-	-	1	-	1	-	2 (2.1)
Scissors	-	-	-	1	1	-	2 (2.1)
Knife	-	-	-	-	1	-	1 (1.1)
Thorn	2	1	1	-	1	-	4 (4.2)
Wooden splinter	-	-	1	-	1	-	2 (2.1)
Firecrackers	4	1	6	1	3	-	15 (15.8)
Ball	-	-	4	1	-	-	5 (5.3)
Chemical lime	-	2	-	-	-	-	2 (2.1)
Others	3	5	24	4	12	2	50 (52.6)
Total	10	9	42	9	23	2	95 (100.0)

Firecrackers and Stone /Glass were the most common object of injury.

List of other objects of injury

Object	Frequency
Accident/Fall	8
Bangle piece/hair clip	2
Bow & arrow	4
Cow horn/tail	3
Cricket bat/hockey stick	2
Door handle	2
Gilli danda	5
Iron rod/wire	12
Pen/pencil	10
Needle	2
Total	50

Table 7. Associated Extraocular Injury

Type of Injury	Total	Extraocular Injury	Percent
Mechanical	**77**	**15**	**19.5**
Chemical	**3**	**2**	**66.7**
Thermal	**15**	**9**	**60.0**
Total	**95**	**26**	**27.4**

In total, about one-fourth of the patients had associated extraocular injury. Among patients with thermal injuries, approximately half the patients had associated extraocular injury.

Table 8. Use of Spectacles at the time of Injury

Wearing	Frequency	Percentage
Worn	**-**	**-**
Not Worn	**95**	**100.0**
Total	**95**	**100.0**

None of the patients were using glasses at the time of injury.

Table 9. Child Participation

Child participation	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Active	4	5	21	2	13	-	45 (47.4)
Passive	6	4	21	7	10	2	50 (52.6)
Total	10	9	42	9	23	2	95 (100.0)

This table shows the number of cases where the child actively sustained injury or got injury as a passive or innocent bystander.

Table 10. Presence of an adult

Adult	Age Group			Total
	0 – 5 Yrs	6 – 10 Yrs	11 – 15 Yrs	
Present, alert	-	1	-	1 (1.0)
Present, not alert	7	11	6	24 (25.3)
Absent	12	39	19	70 (73.7)
Total	19	51	25	95 (100.0)

The great majority of injuries occurred in the absence of a caregiver.

Only in 1% injuries, the child was being supervised by an adult at the time of injury.

Table 11. Place of Injury

Place of Injury	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Home	8	4	24	4	14	2	56 (58.9)
School	-	4	14	4	6	-	28 (29.5)
Work place	-	-	-	-	1	-	1 (1.0)
Public places	2	-	2	-	1	-	5 (5.3)
Others	-	1	2	1	1	-	5 (5.3)
Total	10	9	42	9	23	2	95 (100.0)

Injuries at home were most commonly observed.

Table 12. Occupation of parent

Occupation of parent	Number	Percentage
Industrial Worker	4	4.2
Agricultural Worker	36	37.9
Professional	1	1.1
Business man	10	10.5
Others	44	46.3
Total	95	100.0

Most of the parents of the injured children were from agricultural background.

Table 13. Educational status of parent

Educational level	Number	Percentage
Illiterate	**15**	**15.8**
School	**70**	**73.7**
College	**10**	**10.5**
Total	**95**	**100.0**

More than half of the parents were educated up to school level.

Table 14. Educational level of parent and previous consultation

Previous consultation	Educational level of parent			Total
	Illiterate	School	College	
Ophthalmologist	**2**	**32**	**5**	**39 (65.0)**
Physician	**4**	**8**	**3**	**15 (25.0)**
Quacks	**-**	**3**	**-**	**3 (5.0)**
Medical Shop	**2**	**1**	**-**	**3 (5.0)**
Total	**8**	**44**	**8**	**60 (100.0)**

None of the patients whose parents were educated up to college level received treatment from quacks or any over the counter medications.

Table 15. Educational level of parent and Delay in presentation

Delay	Educational level of parent			Total
	Illiterate	School	College	
<6 hours	3	7	3	13 (13.7)
>6 hrs but same day	1	-	-	1 (1.1)
1 Day	4	18	4	26 (27.4)
2-4 Days	4	28	2	34 (35.8)
5-7 Days	1	9	-	10 (10.5)
8 Days-1 Month	1	7	1	9 (9.5)
>1 Month	1	1	-	2 (2.1)
Total	15	70	10	95 (100.0)

30% of the patients whose parents were educated to college level were brought to the hospital within 6 hours of injury, which was higher when compared to the other two groups.

Table 16. Visual acuity at Presentation

Visual Acuity (with pinhole)	Age						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Vision >6/18	3	5	22	5	6	1	42 (44.2)
6/18 to 3/60	2	1	9	3	7	-	22 (23.2)
Vision <3/60	5	2	11	1	9	1	29 (30.5)
NOPL	-	1	-	-	1	-	2 (2.1)
Total	10	9	42	9	23	2	95 (100.0)

Table 17. Month wise distribution

MONTH	Type of Injury			Total
	Mechanical	Chemical	Thermal	
JUNE	10	1	-	11 (11.6)
JULY	12	1	-	13 (13.7)
AUGUST	16	-	2	18 (18.9)
SEPTEMBER	19	-	-	19 (20.0)
OCTOBER	7	-	4	11 (11.6)
NOVEMBER	13	1	9	23 (24.2)
TOTAL	77	3	15	95 (100.0)

Peaks were seen in the months of September and November.

Majority of thermal injuries secondary to firecrackers were seen in November which is the festival season.

Table 18. Details of treatment at first visit

a) According to age group

	Age Group			Total
	0 – 5 Yrs	6 – 10 Yrs	11- 15 Yrs	
Medical	13	40	16	69 (72.6)
Surgical	6	11	9	26 (27.4)
Total	19	51	25	95 (100.0)

	Age Group			Total
	0 – 5 Yrs	6 – 10 Yrs	11- 15 Yrs	
In Patient	6	16	11	33 (34.7)
Out Patient	13	35	14	62 (65.3)
Total	19	51	25	95 (100.0)

b) According to type of injury

	Type of Injury			Total
	Mechanical	Chemical	Thermal	
Medical	53	2	14	69 (72.6)
Surgical	24	1	1	26 (27.4)
Total	77	3	15	95 (100.0)
	Type of Injury			Total
	Mechanical	Chemical	Thermal	
In Patient	31	1	1	33 (34.7)
Out Patient	46	2	14	62 (65.3)
Total	77	3	15	95 (100.0)

34.7% required admission, while the remaining 65.3 % were treated on outpatient basis.

Table 19. Number of follow-ups for each patient

No. of follow-ups	Age Group			Total
	0 – 5 Yrs	6 – 10 Yrs	11 – 15 Yrs	
1	10	15	6	31 (32.6)
2-3	5	27	15	47 (49.5)
4-5	4	9	4	17 (17.9)
Total	19	51	25	95 (100.0)

Majority of the patients came for 2-3 follow ups.

Table 20. Final Visual Outcome of affected eye

Outcome of affected eye	Age Group						Total
	0 – 5 Yrs		6 – 10 Yrs		11 – 15 Yrs		
	M	F	M	F	M	F	
Vision >6/18 with correction	5	8	35	8	18	2	76 (80.0)
Visual impairment (6/18 – 3/60)	-	-	3	1	3	-	7 (7.4)
Blindness (<3/60)	1	-	2	-	-	-	3 (3.1)
Loss of eye	4	1	2	-	2	-	9 (9.5)
Total	10	9	42	9	23	2	95 (100.0)

80% patients regained a visual acuity of >6/18 with correction.

Table 21. Final visual acuity in relation to vision at presentation, delay in presentation & type of injury

Final Visual Outcome	>6/18	6/18 – 3/60	<3/60	Loss of eye	Total	p-value
Vision at presentation						
>6/18	42	-	-	-	42	<0.001
6/18 – 3/60	19	2	1	-	22	
<3/60	15	5	2	7	29	
NOPL	-	-	-	2	2	
Delay in presentation						
<6 hrs	10	-	1	2	13	0.130
>6 hrs but same day	1	-	-	-	1	
1 day	23	-	1	2	26	
2 – 4 Days	26	7	-	1	34	
5 – 7 Days	8	-	1	1	10	
8days – 1 month	6	-	-	3	9	
>1 month	2	-	-	-	2	
Type of Injury						
Mechanical	60	7	2	8	77	0.790
Chemical	3	-	-	-	3	
Thermal	13	-	1	1	15	
TOTAL	76 (80.0)	7 (7.4)	3 (3.1)	9 (9.5)	95(100.0)	

Table 22. Final visual acuity in relation to presence of an adult and educational level of parent

Final Visual Outcome	>6/18	6/18 – 3/60	<3/60	Loss of eye	Total	p-value
Presence of an adult						
Absent	57	7	2	4	70	0.305
Present, not alert	18	-	1	5	24	
Present & alert	1	-	-	-	1	
Educational level of parent						
Illiterate	13	1	1	-	15	0.272
School	57	5	2	6	70	
College	6	1	-	3	10	
TOTAL	76 (80.0)	7 (7.4)	3 (3.1)	9 (9.5)	95(100.0)	

Presence of adult (p-0.305) and education level of parent (p-0.272) did not reach statistical significance in influencing final visual outcome.

Initial Visual Acuity * Final Visual Acuity Crosstabulation

Count

Initial Visual Acuity	Final Visual Acuity										Total
	NOPL	PL	1/60	6/60	6/36	6/24	6/18	6/12	6/9	6/6	
NOPL	2										2
PL	6	1	1					1	2		11
HM	1				1	1		1	2	2	8
FCF						1		1	1	1	4
0.5/60								1			1
1/60				1				1			2
2/60							1			2	3
3/60								1		1	2
4/60						1			1		2
5/60							1	1			2
6/60									1	1	2
6/36			1					1		4	6
6/24									1	2	3
6/18									4	1	5
6/12								1		3	4
6/9									1	10	11
6/6										27	27
Total	9	1	2	1	1	3	2	9	13	54	95

DISCUSSION

Our study had a total of 95 patients, out of which, 78.9% (75) were boys and 21.1% (20) were girls. The minimum age was 3 years and the maximum was 15 years. The mean age of injured patients was 8.5 years. 20% were in the age group 0-5 years (53% boys, 47% girls), 53.7% in 6-10 years (82% boys, 18% girls), 26.3% in 11-15 years (92%% boys, 8% girls).

Authors	**No. of cases**	**Male (%)**	**Female (%)**
Our study	95	79	21.1
Niiranen & Raivio (Finland) [117]	110	82	18
Rapoport et al (Israel) [119]	242	72	28
Al-Bdour et al (North Jordan) [121]	116	72	28
MacEwen et al (Scotland) [123]	415	70	30
Thompson et al (Australia) [125]	72	67	33
Vasnaik et al (Bangalore) [126]	68	62	38
Mela et al (Greece) [127]	103	80	20
Serrano et al (Colombia) [128]	393	65	35
Yaga G et al (France) [129]	194	59	41
Grieshaber et al (S Africa) [131]	100	70	30

As can be seen from the above comparison, male preponderance is a common feature of eye injuries in children. Thus, our findings are consistent with that of all other similar studies, as is the marked increase of

the male-female ratio in children older than age of 5 yrs. A possible explanation for this fact is the greater liberty and stimulus to aggressiveness given to boys in almost all societies.

Most of the children in our study were older than four years. School-aged children, in particular, are most often exposed to the environment and tend to be more physically active. As well, they often take higher risks to gain acceptance from their peers. This is reflected in the types of games they play and in how they react to conflictive situations.

The right eye was little more commonly affected (54.7%) then the left eye (38.9%). This was similar to the Australian study by Thompsom et al[125] were right eye was involved in 54% of the cases and in the study done by Mac Ewen et al in Scotland[123] the right eye was involved in 52% of cases. In our study there were 6 cases with bilateral injury (6.3%).

Half of our patients (51.6%) came from rural areas, but this could be because of our geographical location. None of these studies so far on eye injuries in children have concentrated on this aspect.

81.1% of the injuries were mechanical, 3.1% chemical and 15.8% thermal. Associated extraocular injuries were found in overall 27.4% injuries. 60% of thermal injuries had associated extraocular injuries.

All the 15 cases of thermal injury were due to fire crackers and the peak was seen during the festival season in November. Most other studies found slightly lesser incidence of burn injuries. The Israeli study done by

Rapoport et al[119] found it to be 10% while the study done by Strahlman et al in Maryland (Wilmer study) [120] found it to be 9%. Only in the Brazilian study by Moreira et al[118] burns constituted 20% of the injuries.

The study at Maryland done by Strahlman et al[120] (78%) and Brazilian study by Moreira et al[118] (70%) had a lesser incidence of mechanical injuries, whereas Rapoport et al (Israel) [119] (89%) and Mac Ewen et al (Scotland) [123] (93%) reported higher incidence of mechanical injuries.

Pointed objects like sticks, thorns, knifes,scissors being poked into the eye or thrown at the child accounted for majority of the mechanical injuries. Injuries from sticks occurred frequently when children played games like 'gilli danda' or while playing 'war' games. Thorns, stones and pens were not found to be causative agents for injuries in children under the age of 5 yrs. These finding were similar to the South African study by Grieshaber et al[131] and the Australian study by Thompsom et al[125]. None of the childrens in this study were wearing glasses at the time of injuries. The child actively participated in 47.4% of injuries (45 cases), while in the remaining 52.6% the child was a passive onlooker.

The great majority of injuries occurred in the absence of caregiver. In 73.7% of the cases, the child was alone at the time of injury, while in 25.3% of cases, an adult was present but not alert. Only in 1% (1 cases), the child was being supervised by an adult at the time of injury. In the Brazilian study

by Moreira et al [118], 57% of injuries occurred in absence of an adult, in 34% cases adult was present but not alert, while in only 9% cases, an adult was supervising over the child at the time of injury. Similar observations were reported by Grieshaber et al [131] were 85% of the injuries occurred in the absence of a caregiver and by Moreira et al [118] were 53% of the injuries occurred when the child was alone.

In terms of place, the home (58.9%) was the most common place for eye injuries to occur. In the age group 0-5 years, almost 63% of the injuries occurred at home. Among older children 64% injuries occurred at home, around 30% at school and the rest in other places like street/public places. These findings were similar to all studies conducted till now. Macewen et al[123] reported 51%, Thompson et al[125] 58% , Mela et al[127] 45%, and Grieshaber et al[131] reported 55% as the proportion of injuries occurring at home.

We also made a note of the educational level, income level, and occupation of the parent. 16% of the parents were illiterate, 74% were educated upto school level & 11% upto college level or beyond. 38% of the parents were agricultural workers, 11% were involved in business, and 46% were employed in other occupation, majority of them being laborers working on daily wage basis.

The time interval between injury and presentation to our institution is shown in table 15. Only 13.7% patients were brought to our institution

within 6 hours of injury, one case came after 6 hours, but within the same day.

Majority of the patients (35.8%) presented after 2-4 days of injury, another 27.4% presented 1 day after injury, another 10.5% after 5-7 days, and 9.5% after 1 week. 2 cases presented more than 1 month after injury. There was a trend towards early attendance, within 48 hours, the more severe the injury, & the younger the child.

30% of the patients whose parents were educated upto college level or beyond, were brought to the hospital within 6 hours of injury, which was only 10% in children of school-level educated & 20% in illiterate parents. Reasons cited for delay in presentation were distance to the hospital , financial problem, negligence, delayed referral, no symptoms. Similar observations were made in studies done by Serrano et all [123] & Grieshaber et al [131].

Observing the elapsed time between injury and medical care, it is apparent that in the lower socio-economic strata (low education & income levels), the period is much longer than that in higher socio-economic strata, regardless of whether the injury was mild or severe.

Overall 60 (63%) patients had received some form of treatment prior to presenting to our institution. 65% of these had been treated by an ophthalmologist, 25% by a general physician, 5% consulted quacks and 5% used over the counter drugs, without consultation. 63% of patients whose

parents were educated till college level or more had received prior treatment from ophthalmologists and the remaining 37% from general practitioners. None of the patients in this category received treatment from quacks or over the counter drugs.

The maximum number of eye injuries occurred in the month of November. Majority of these were firecracker injuries. This coincided with the festival season where children had more access to fireworks. Similar observations have been reported in other Indian studies.

At the time of presentation, 44.2% cases had vision >6/18 with pinhole, 23.2% had 6/18 – 3/60, 30.5% had <3/60, 2 cases (2.1%) had no perception of light. 26 patients (27.4%) required surgical intervention at presentation while the remaining 69(72.6%) were treated medically. In the study done by Macewen et al[123], 48% patients required surgical treatment while the rest of the patients were managed medically. In the study by Serrano et al[128], 23% required surgical intervention. 33 patients (34.7%) required admission, while the remaining 65.3% were treated on outpatient basis.

32.6% of patients came back for only 1 follow-up, 49.5% came for 2-3 follow-ups, 17.9% for 4-5 follow-ups. For the present study, final visual acuity was classified as vision > 6/18 with correction, “visual impairment” (vision 6/18 – 3/60), “blindness” (vision <3/60), “loss of eye” (phthisis).

The final visual outcome was overall good. 80% patients regained a visual acuity of > 6/18 with correction, 7% were rendered visually impaired, 3% were blinded, 10% of the eyes went for phthisis bulbi. The final visual outcome in studies conducted in other countries were slightly better than ours, pointing towards the need for better trauma management in our country. We compared the final visual acuity with 5 variables to determine the influence of each on the final visual outcome.

As can be expected, the relation between visual acuity at presentation and final visual acuity was statistically significant ($p<0.001$). The time elapsed between injury and consultation also was an important factor in determining final visual outcome. Later the presentation, worse was the prognosis ,more so in severe injuries, and injuries complicated by the use of native medication use & sepsis. Similar findings were reported by Grieshaber et al[131].

Other variables like type of injury (p-0.790), presence of adult (p-0.305), education level of parent (p-0.272) did not reach statistical significance in influencing final visual outcome.

SUMMARY AND CONCLUSION

The limitations in our study are,

1. The follow up is only for a brief period of time and the population size is small. Long term follow up of a larger population of children with eye injuries would provide information that is crucial to completely assess the public health impact of pediatric eye trauma and its associated ocular morbidity.
2. The Incidence of permanent visual loss cannot be predicted from the incidence rates of eye injuries because many of the vision-threatening complications of such injuries(eg. retinal detachment, cataract) develop months after the initial event
3. Many of the patients in our study came from socioeconomic situations that did not allow for regular follow-up evaluation
4. The current study included only children who presented to us with a primary diagnosis of ocular trauma excluding those with traumatic injury who would have sought neurosurgery or plastic surgery services.
5. This study did not investigate how the management of a condition should be adjusted or improved based on individual etiology. This topic requires an additional prospective study in the future.

Though there are limitations, an important point that can be concluded from the data presented in this study is that it clearly indicates that the majority of pediatric eye injuries are preventable.

Diwali crackers are more dangerous. The cornea shows the highest incidence of involvement because it is the most exposed part of the eye ball. The necessity of seeking professional medical help soon after the injury and the danger of delaying treatment should be stressed. To maximize outcomes, immediate and careful evaluation and treatment by ophthalmologists is advocated .

The present survey confirms that elementary schoolchildren are the most vulnerable age group who cannot be fully responsible for their actions. Hence, parents and carers need education in preparing the home environment to be safe for children. Adequate supervision and appropriate ocular protection for children must be stressed especially when using sharp tool or scissors. Safer tools such as blunt nosed scissors should be provided and access to sharp or dangerous household utensils should be restricted. Plants with thorns are not suitable in gardens with children. Games involving throwing projectiles should be disallowed.

The government should take action legally to abolish the habit of bursting crackers for Diwali. If it is not possible, children should be supervised by responsible adults while bursting crackers.

Possible avenues of dissemination of this information would be through schools, medical practices and baby health clinics and through media.

FUTURE DIRECTIONS

The findings warrant consideration of further collaborative multicenter studies to provide a more comprehensive view of the epidemiology of pediatric ocular trauma in our country and to create a registry or database.

In addition, education programs can be targeted to decrease the risk of pediatric eye injuries among various populations. For example, children in the current study population were most likely to be injured at home by sharp objects. Thus, it would be interesting to study whether a public safety education program targeted toward parents/caregivers in the home would decrease the incidence of ocular trauma.

The results of this study can also be used to influence the safety processes of relevant manufacturers.

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PROFORMA

STUDY ON CHARACTERISTICS AND OUTCOME OF PAEDIATRIC EYE INJURIES (SCOPE)

S.No. : ☐ MR No : ☐

Name : _____ Sex : ☐ [1 – Male;2-Female]

Age : ☐

Laterality : ☐ [1 – RE; 2-LE; 3-BE]

Domicile : ☐ [1-Urban, 2-Semi Urban; 3-Rural]

Type of Ocular Injury : ☐ [1-Contusion ; 2- Non penetrating laceration; 3 – Penetraing Injuries; 4- Intraocular Foreign body; 5-Scleral Perforation ; 6-Chemical burns; 7-Rupture globe; 8- Others]

If others, describe : _____

Extra ocular Injury : ☐ [1- Yes ; 2-No]

Object of Injury : ☐ [1- Sharp; 2-Blunt; 3-Chemical and Thermal burns; 4-Others----------)

If the object of injury is Sharp, specify: ☐ [1-Stone Glass; 2-Metal piece of Fragment; 3-Scissors; 4-Knife; 5-Thorn; 6-Wooden splinter; 7-Bird peck; 8- Animal injuries; 9-Vehicular injuries; 10-Fire crackers explosive; 11-Ball; 12-Chemical lime; 13-Others_____)

Place of Injury : ☐ [1-Home; 2-School; 3-Workplace; 4-Public Place like roads; 5-Others)

Was the child wearing spectacles: ☐ [1 – Worn; 2-Not worn]

Type of Lenses : ☐ [1- Glasses; 2- Plastic]

Child Participation	:	☐	[1-Active; 2-Passive]
Presence and level of attention of an alert, 3-Present and alert]	:	☐	[1-Absent; 2-Present, Not
Occupation of Parent	:	☐	[1-Industrial Worker; 2-Agricultural Worker; 3-Professional; 4-Business man; 5-Others]
Educational status of parent	:	☐	[1 – Illiterate; 2-School; 3-College]
Income level of parent	:	☐	[1-Below 1000; 2-1000 to 3000; 3-3000 to 5000; 4- >5000]
Visual Acuity with PH	:	☐	RE ☐ LE
Date of Injury	:		___/___/___ Time_____
Date of reporting	:		___/___/___ Time_____
History of previous treatment	:	☐	[1-Yes ; 2-No]
If Yes, then	:	☐	[1-Ophthalmologist; 2-Physician; 3-Quacks; 4-Medical Shop; 5-Others]
Diagnosis	:		RE_____
			LE_____
Treatment	:	☐	[1 – Medical ; 2-Surgical]
	:	☐	[1- In patient ; 2-Out Patient]

FOLLOW UP

SNO: **MR NO:** **NAME:**

Follow up Number :

Date of Follow-up visit : _____ /____ / _____

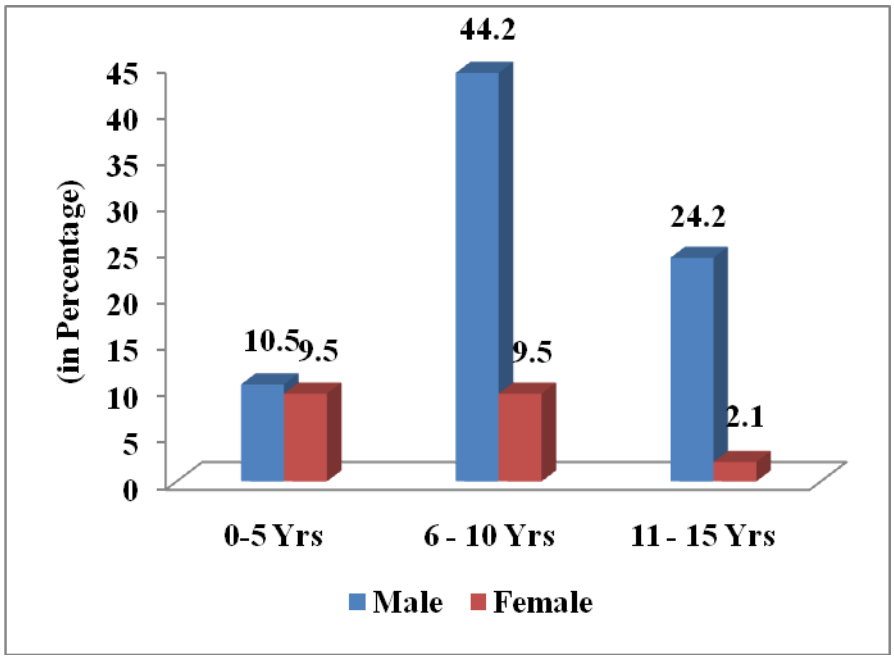
Visual Acuity : ☐ RE ☐ LE

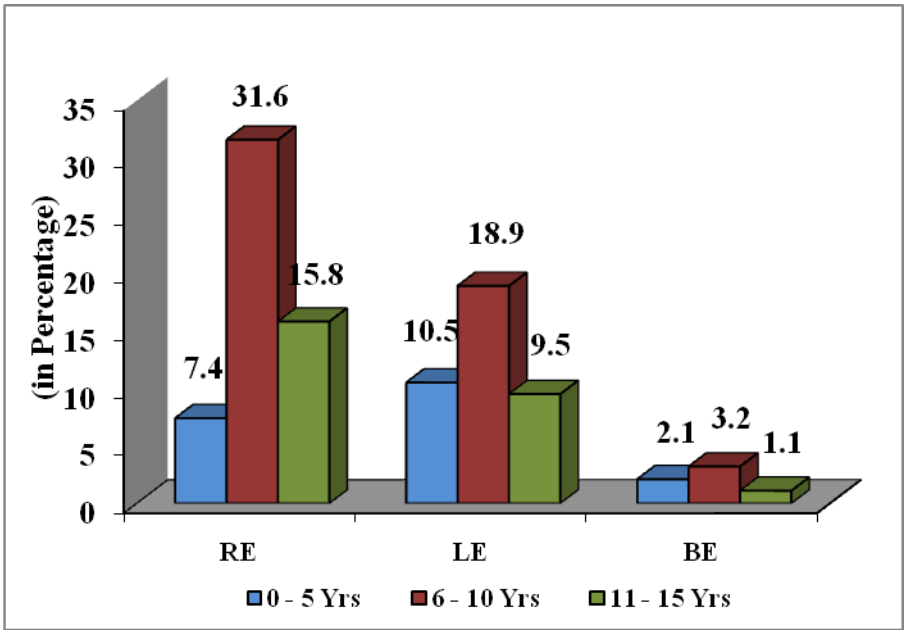
Treatment : ☐ [1-Medical; 2-Surgical]

☐ [1-In patient; 2- Out patient]

Outcome of the affected eye : ☐ [1-Vision >6/18 with correction;
2-Visual impairment (6/18-3/60);
3-Blindness (<3/60); 4- Loss of eye
(pthisis); 5- Removal of eye]

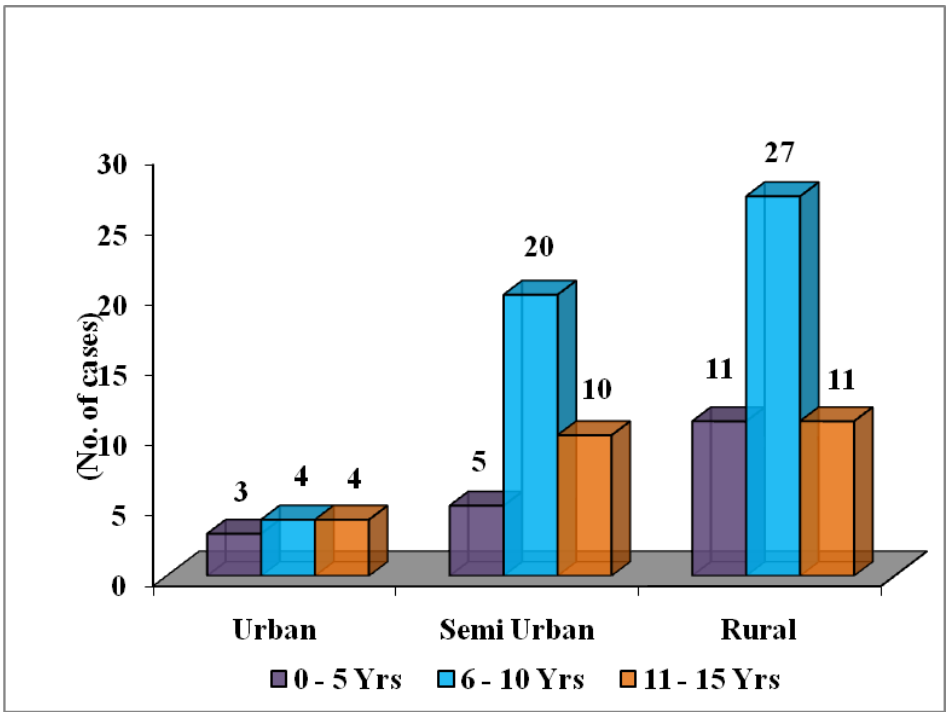
Age Distribution



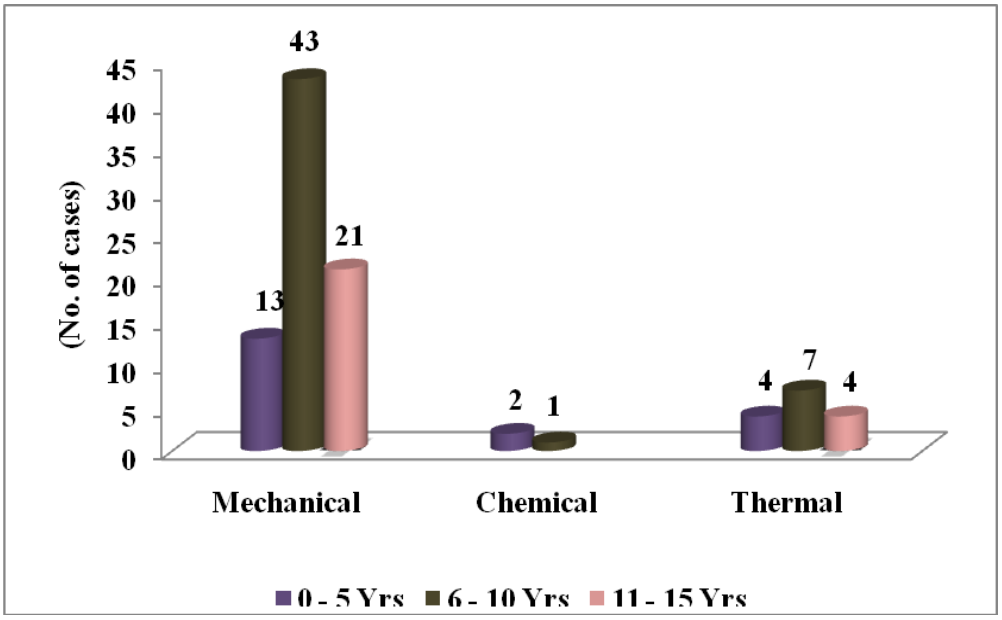


Laterality

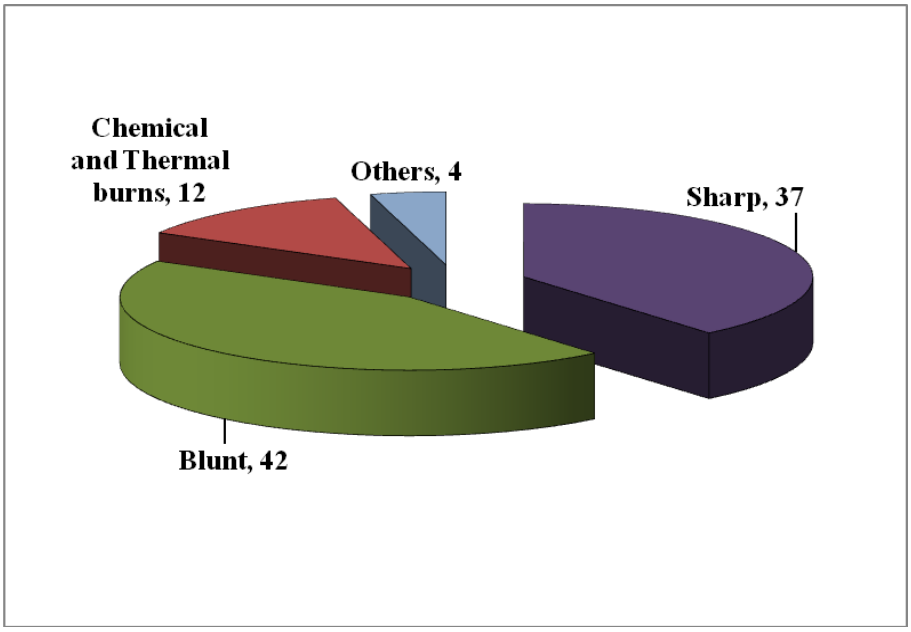
Domicile



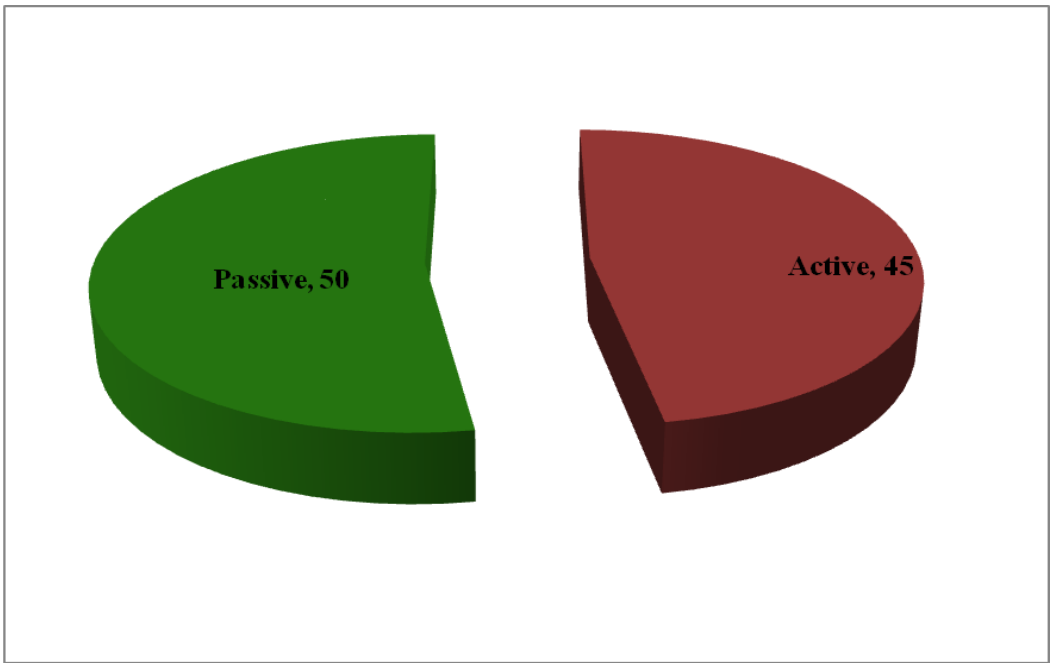
Type of Ocular Injury



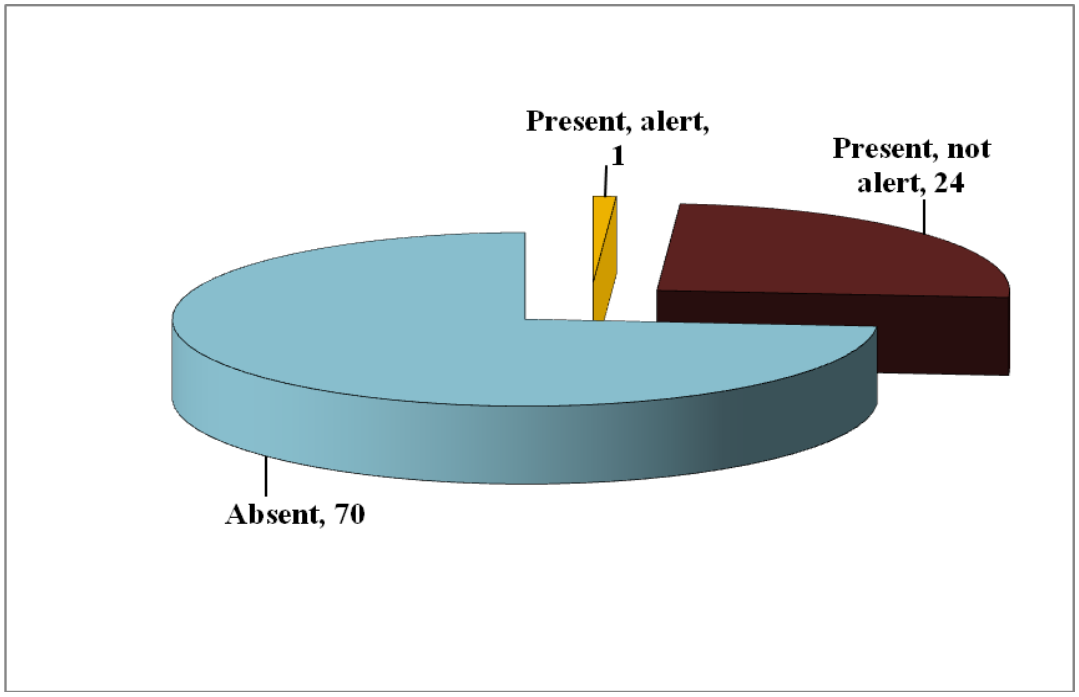
Object of Injury



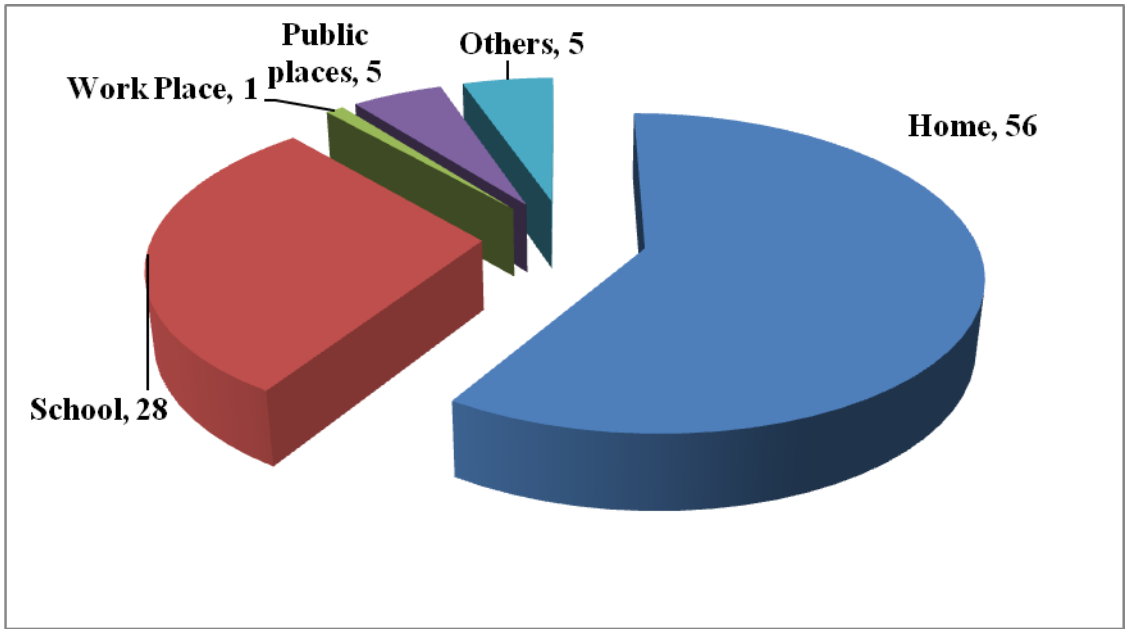
Child Participation



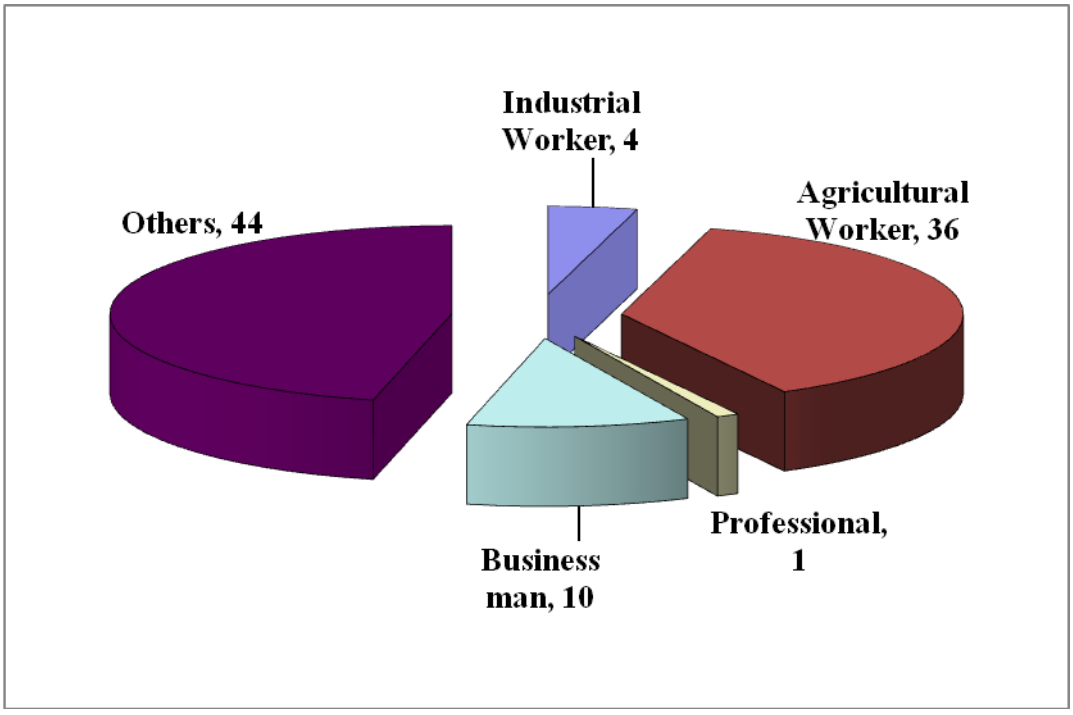
Presence and level of attention of an adult



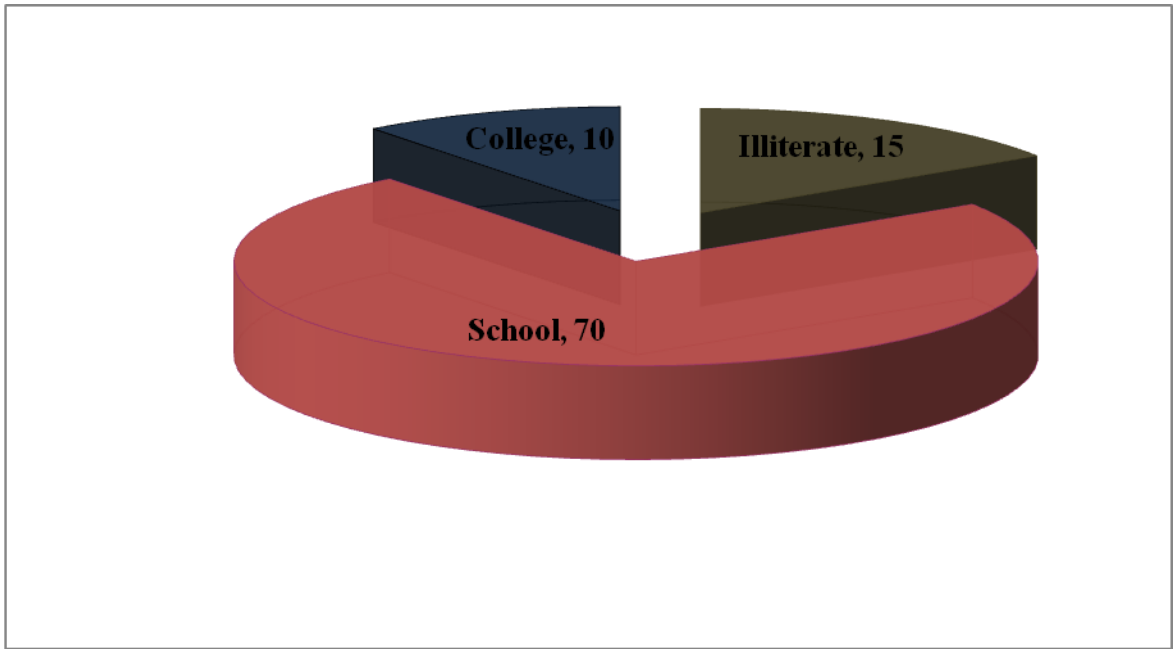
Place of Injury



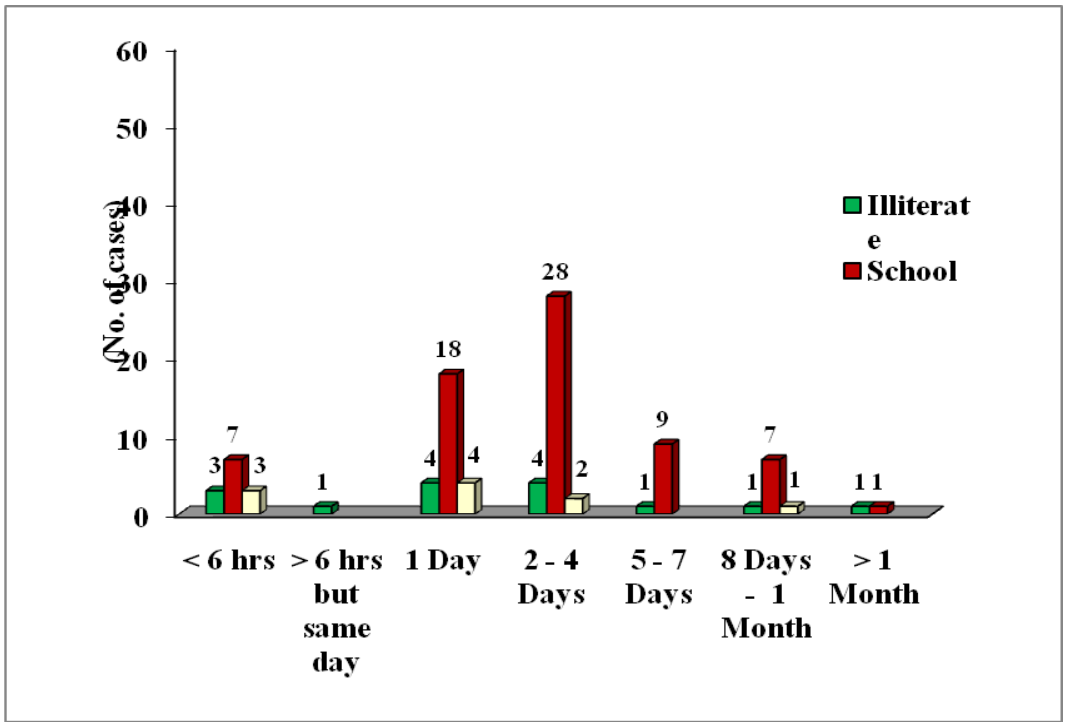
Occupation of the Parent



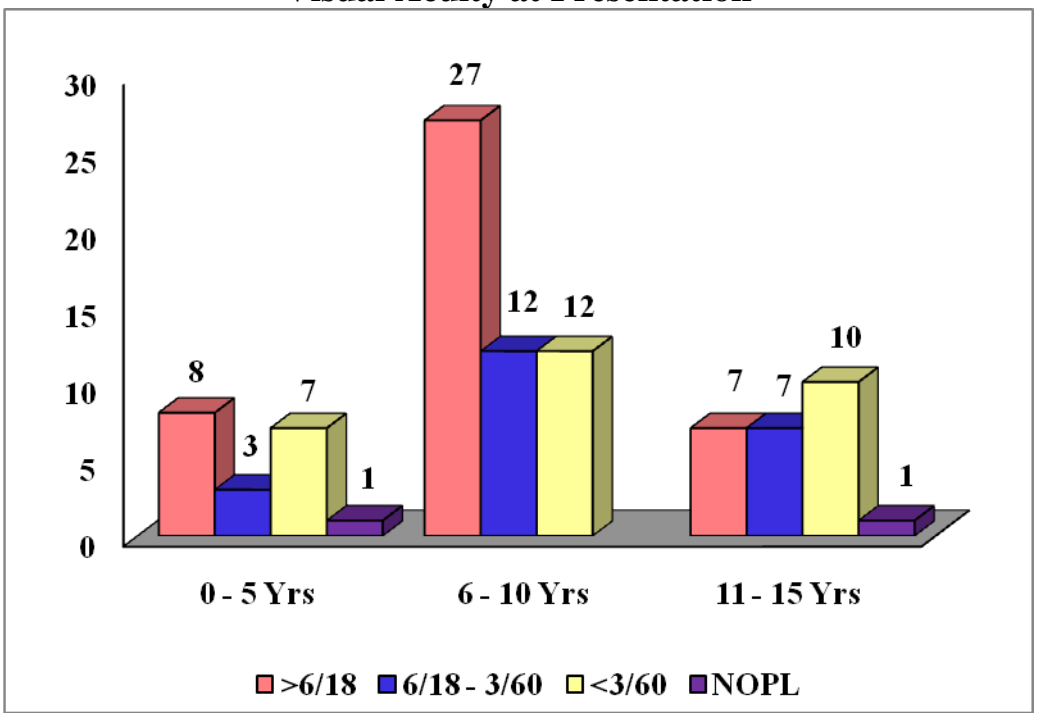
Educational Status of the Parent



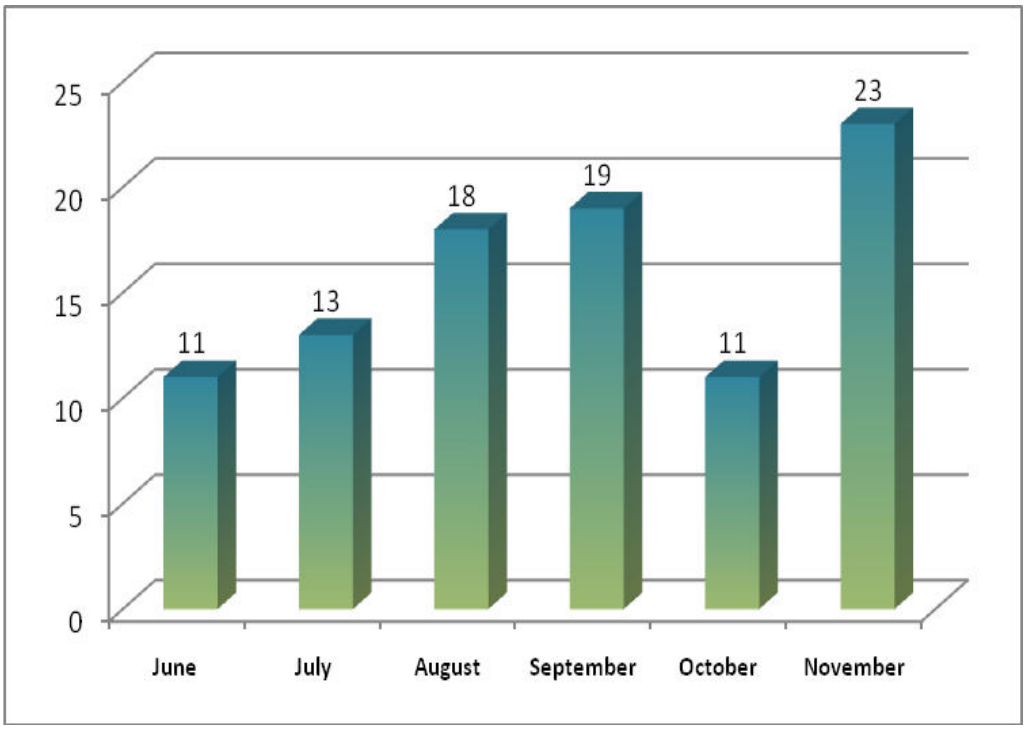
Relation between education level of parents and delay in presentation



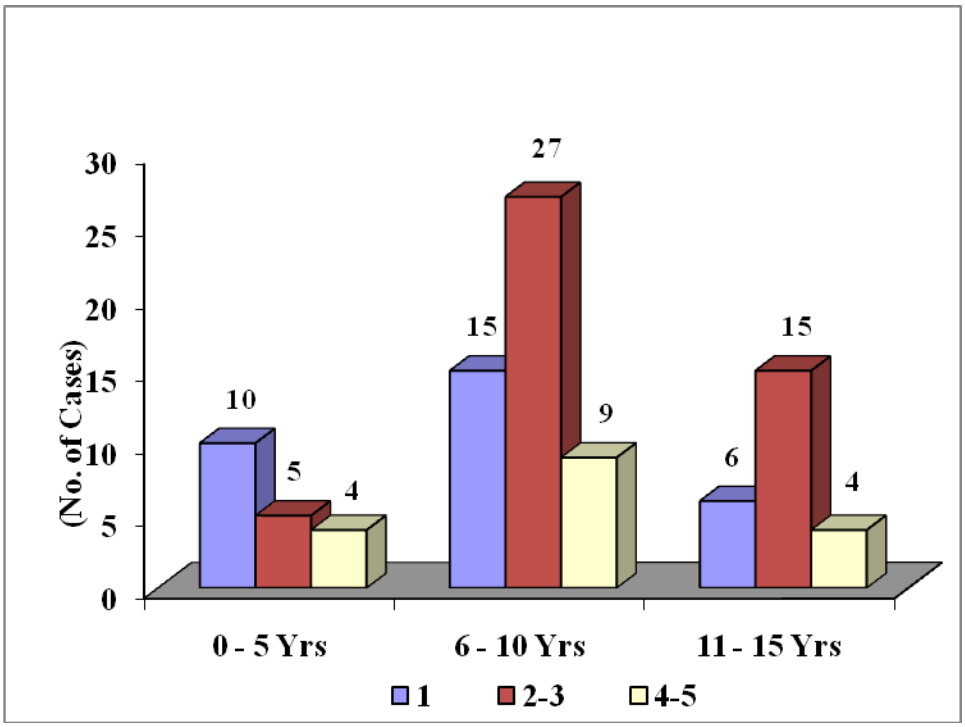
Visual Acuity at Presentation



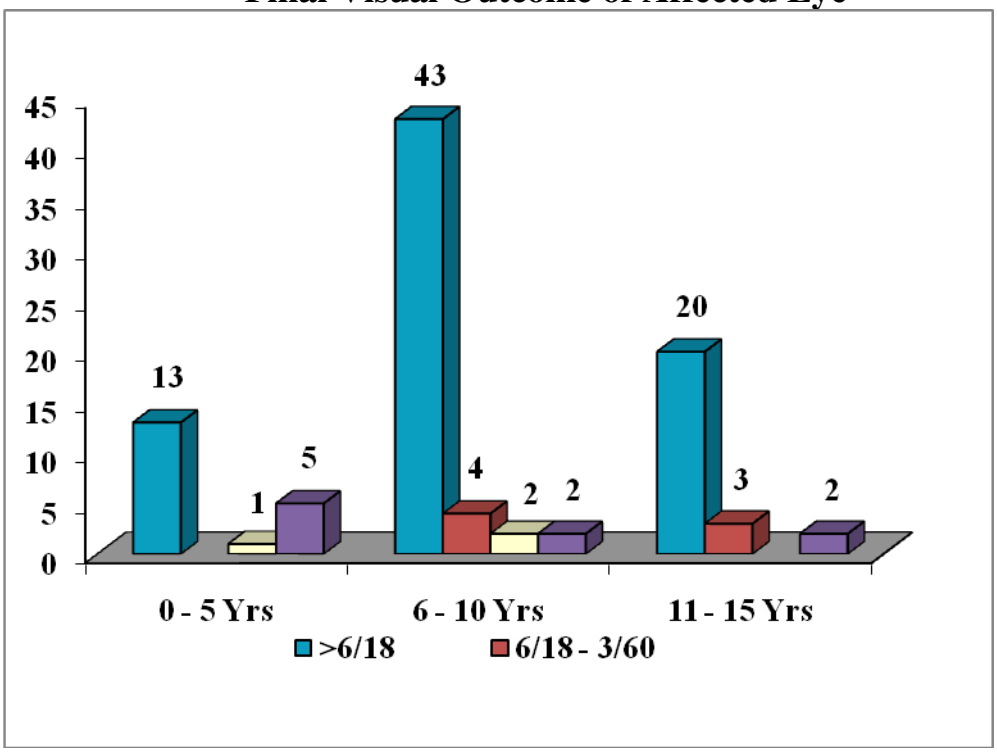
Month wise Distribution



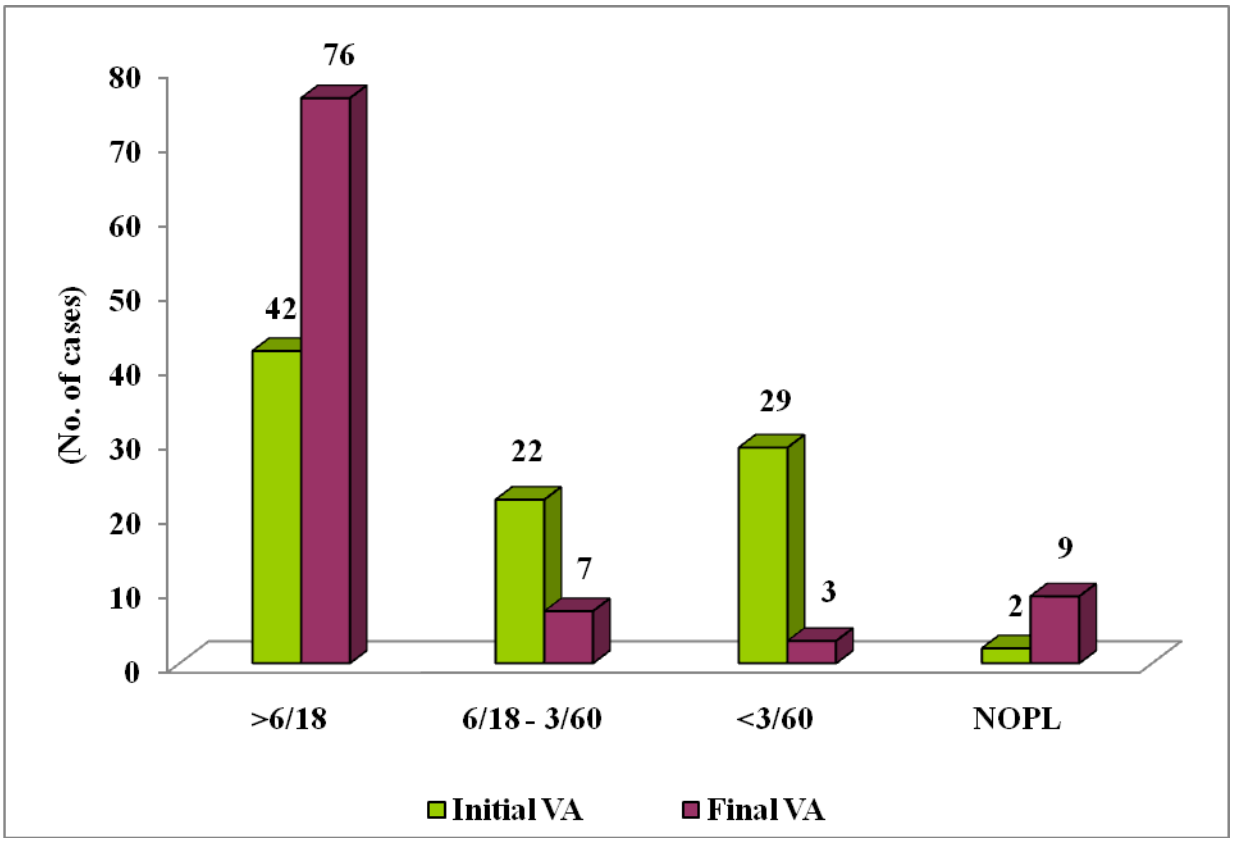
Number of Follow-ups for each patient

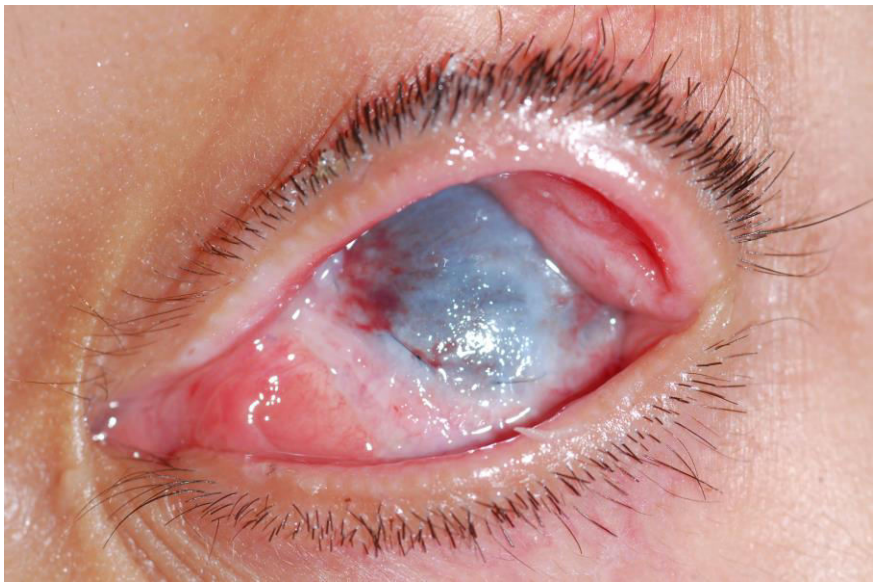


Final Visual Outcome of Affected Eye



Comparison of Visual Acuity

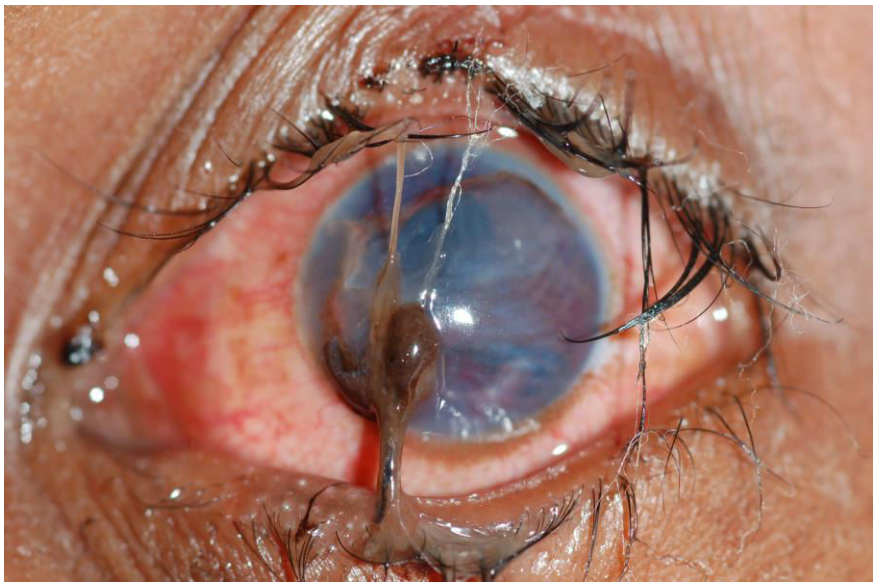




CHEMICAL INJURY GRADE 2

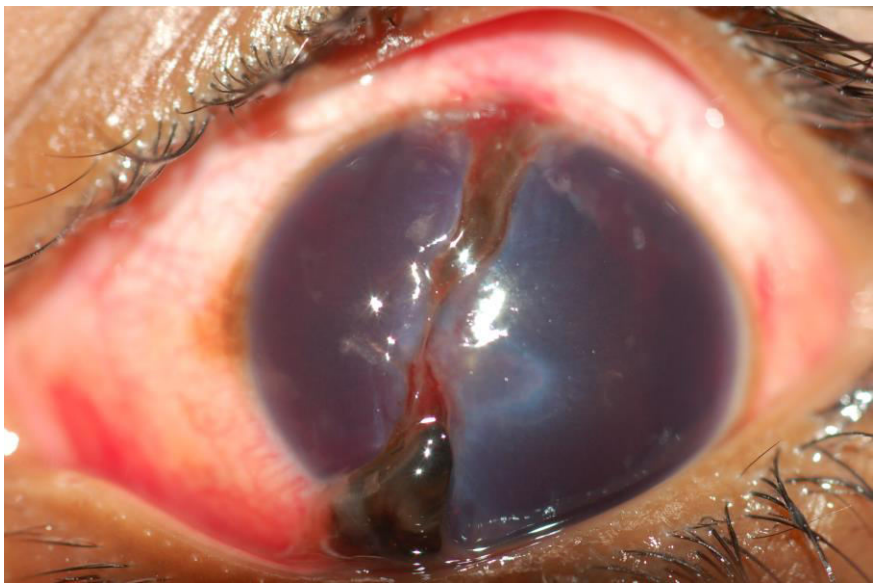
CHEMICAL INJURY GRADE 4

FIRE CRACKER INJURY CAUSING THERMAL BURN



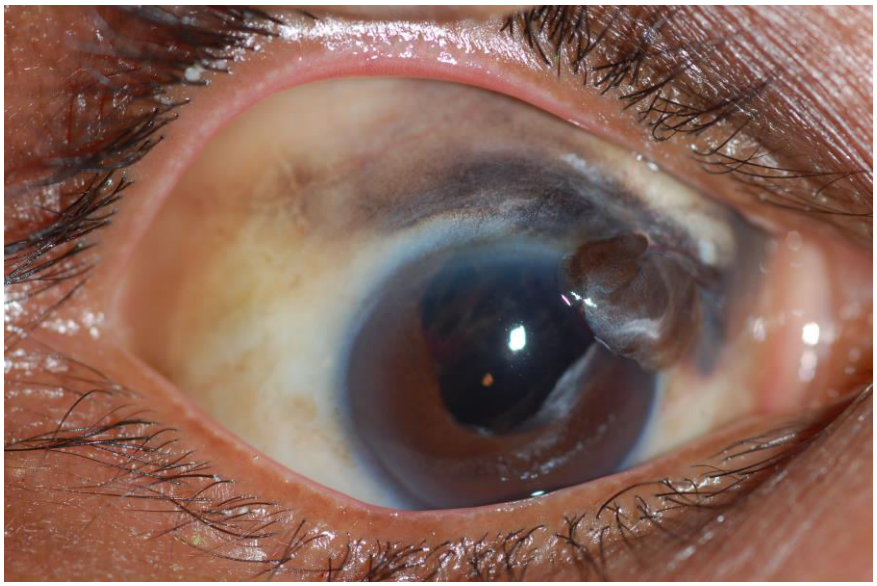
GLOBE RUPTURE

THERMAL BURN OF BOTH LIDS

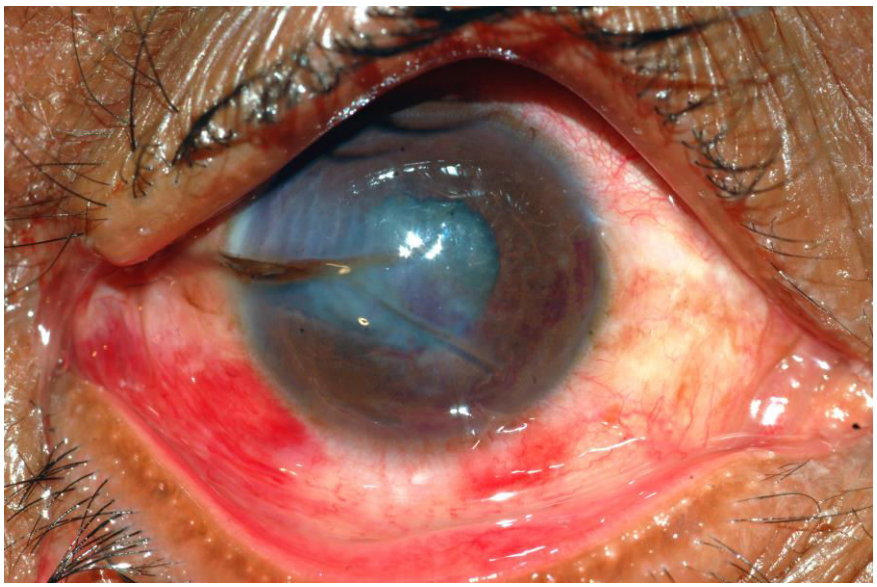


TRAUMATIC CORNEAL TEAR WITH UVEAL PROLAPSE

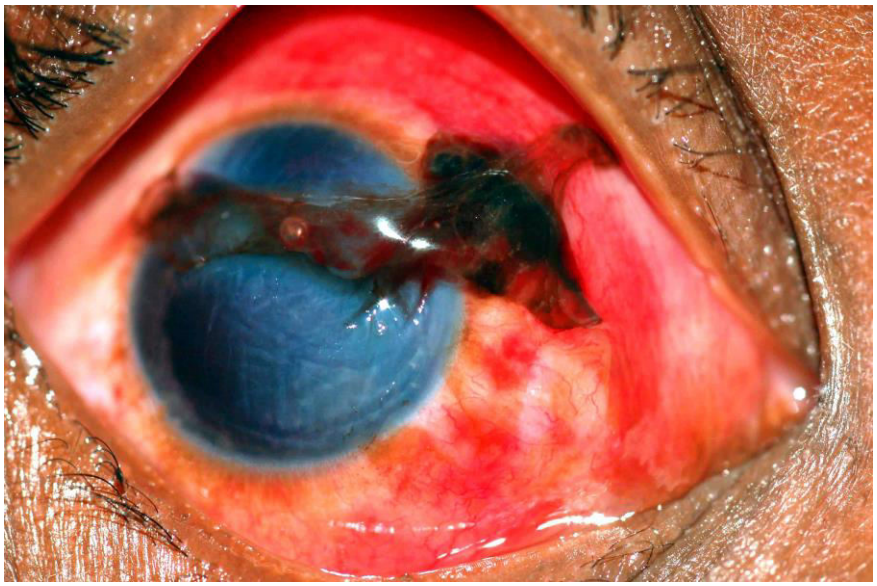
TRAUMATIC CORNEAL TEAR WITH UVEAL PROLAPSE (1)



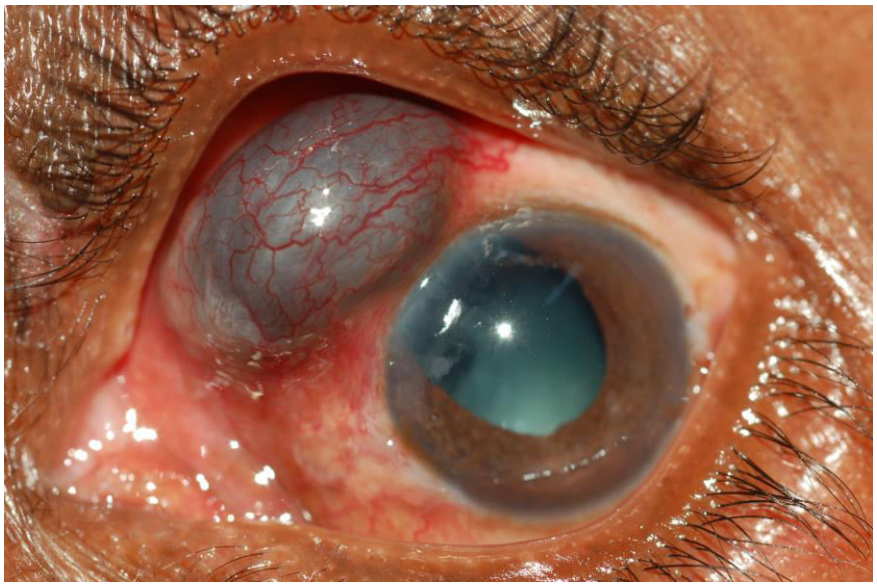
TRAUMATIC UVEAL PROLAPSE



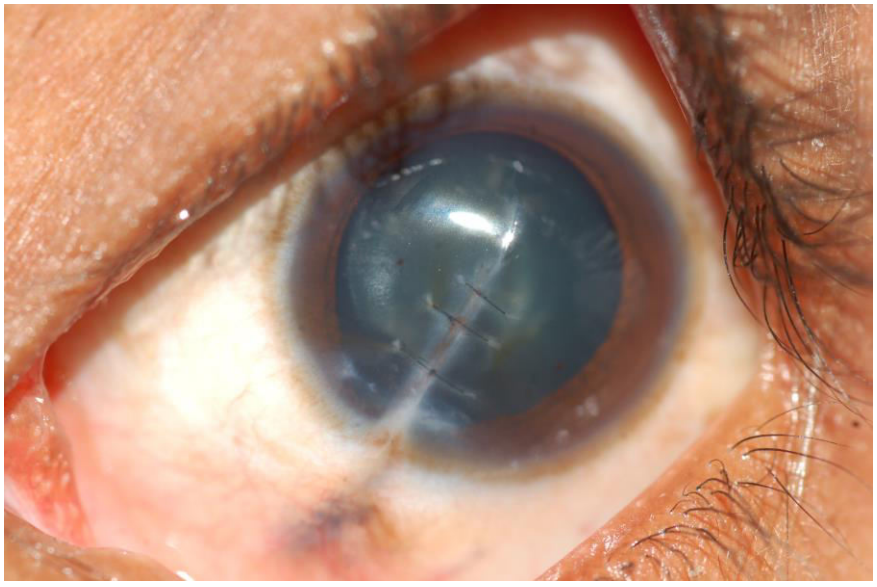
OPEN GLOBE RUPTURE



POST TRAUMATIC GLOBE RUPTURE



SCLEARAL TEAR WITH TRAUMATIC CATARACT



SUTURED CORNEAL TEAR