A RETROSPECTIVE STUDY ON THE SEVERITY AND MANAGEMENT OF PEDIATRIC OCULAR INJURY IN CENTRAL HOSPITAL SAPELE, DELTA STATE (2020-2024)

BY

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FEBUARY, 2025.

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A PROJECT SUBMITTED TO THE DEPARTMENT OF OPTOMETRY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY.

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FEBURARY, 2025.

CERTIFICATION OF APPROVAL

This is to certify that the project titled **A RETROSPECTIVE STUDY ON THE SEVERITY AND MANAGEMENT OF PEDIATRIC OCULAR INJURY IN SAPELE, DELTA STATE (2020-2024)** was done by **AGBIKIMI AKPESIRI VERITY** from the Department of Optometry Life Sciences, University of Benin, Benin City.

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EXTERNAL EXAMINER **DATE**

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DEDICATION

I dedicate this project to The Lord God Almighty, who has preserved my life and kept me in good health throughout my journey at the University of Benin.

I also dedicate this project to myself, for doing my best and giving this work my all.

I also want to dedicate this project to my wonderful parents, Mr and Mrs Sunday Agbikimi for their love, steadfast moral and financial support, and to my siblings and friends for their emotional support and care.

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I thank the Almighty God for keeping me alive and well during the course of this research and also for making me overcome all the challenges encountered during the research.

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ABSTRACT

Pediatric ocular trauma is a significant public health concern, with potential long-term consequences on vision and quality of life. This study was aimed at investigating the severity and management of pediatric ocular injuries in Sapele, Delta State. A retrospective study was carried out to analyze the clinical record of pediatric patients that presented to Central Hospital within January 1st, 2020 to October 1st, 2024. A total of 223 patients, males 139 (62.3%) and females 84 (37.7%), were found to have pediatric ocular injury with a mean age of 11.46 ± 4.7. The most common type of injury sustained was the closed globe injury (76.1%) followed by open globe injury (6.7%) while thermal injury (1.8%) was the least frequently seen. Injuries were found to be caused by physical assault (14.4%), broomsticks (6.3%) and even self-inflicted (5.3%). The cornea was the most affected structure (57.4%) by pediatric ocular injury. An initial visual acuity of 6/6 was recorded (22.6%) for a good percentage of the patients that were compliant. There was a statistically significant relationship between the initial visual acuity and the cause of injury ($p<0.05$). Majority of pediatric ocular injuries (87.9%) that presented to the hospital were managed medically. Corneal ulcer was the most common (n=77) diagnosis of pediatric patients that visited the hospital and it took an average of one week to heal. More than half of the pediatric patients had mild injuries (57.8%). Chi-square test was used to determine if there was significant relationship between the severity of injury and initial visual acuity. The result gave $p<0.05$ showing that there was a statistically significant relationship. 49 eyes (22.0%) of the patients were found to have a visual acuity of <3/60-NLP at presentation, while 23(10.3%) were found to have severe visual impairment after treatment. There is a significant risk of visual loss associated with ocular trauma and thus, the need for effective methods to prevent its occurrence.

Keywords: Pediatric ocular trauma, corneal ulcer, severe visual impairment, visual acuity

CHAPTER ONE

1.0 INTRODUCTION

The eye, though anatomically appears to be a small structure sitting on the face, is the third most common organ affected by injury after the hands and the feet (Onyemaechi *et al.,* 2021). In developing countries with a huge burden of communicable and nutritional diseases, pediatric injuries have been estimated to account for 13% of childhood disease burden (Al-Hajj *et al.,* 2020). However, with increasing urbanization, motorized transportation and armed ethno-religious conflicts, trauma is displacing malnutrition and communicable diseases as a major cause of childhood morbidity and mortality in developing countries (Onyemaechi *et al.,* 2020).

Ocular trauma accounts for 2-14% of all the injuries in the pediatric age group, which if managed with timely intervention helps avert permanent visual disability (Alabdulkader *et al.,* 2024). These injuries may occur at any age; even in-utero. The pattern and mechanism of ocular injuries is different from those in adults. The differences in pediatric eye anatomy and more severe inflammatory reaction than adults can change the prognosis in pediatric patients. In addition, children aged seven years and below are likely to develop amblyopia from ocular trauma. Initial evaluation is difficult as children make for poor historian and are less likely to co-operate during ocular examination. Such difficulties often persist during the follow-up period (Bayar *et al.*, 2022).

Ocular injuries in children are commonly caused with objects such as pencils, stone, firecrackers and domestic sharps. The prognosis of eyes with globe injury is variable and depends on the type of injury, the location of the wound, the extent of the laceration, posterior segment involvement, and the presence of infection. Although one-quarter of the injuries are non-penetrating, perforating injuries of the eye are a frequent cause of unilateral visual loss. Most pediatric eye injuries (66.2%) occur during play – predominantly whilst at home under supervision of parents, caregivers (47.7%), but often whilst at school / nursery (24.4%). Sharp instruments are the most common cause of injury, followed by plants, animals, toys or sports equipment (Sii *et al*., 2018)

1.1 Background Information

The human eyeball is a reasonably well-protected structure by many physiological and anatomical factors. The bony orbit with its elastic fatty tissue as well as the eyelids provides the anatomical protection, while the blink reflex together with the head-turning reflex and the copious lacrimation following intrusion of any irritant material give the physiological protection (Abraham *et al.,* 2021).

1.1.1 The Bony Orbit

The bony orbit (eye socket) are bilateral and symmetrical cavities in the head. They enclose the eyeball and associated structures. It is pear shaped with the optic nerve at the stem and approximately 30 cc volume (Leiger *et al*., 2019). The entrance to the globe anteriorly is approximately 35 mm high and 45 mm wide. The depth from the orbital rim to the orbital apex measures 40 to 45 mm in adults. The maximum width is 1 cm behind the anterior orbital margin. Both race and gender can affect the measurements of the bony orbit.

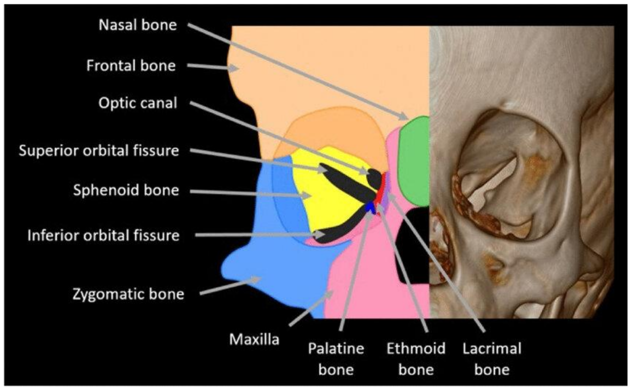
The orbital cavity contains the globe, nerves, vessels, lacrimal gland, extraocular muscles, tendons, and the trochlea as well as fat and other connective tissue (Grech *et al.,* 2014). There are seven bones that form the Orbit: Sphenoid, Frontal, Zygomatic, Ethmoid, Lacrimal, Maxilla, Palatine.

The orbital roof consists of two parts of two bones, the orbital plate frontal bone and the lesser wing of the sphenoid bone (Moore *et al.,* 2010). The medial orbital wall consists of four bones, the frontal process of the maxillary bone: the lacrimal bone, the orbital plate of the ethmoid bone, and the lesser wing of the sphenoid bone. The largest part of the medial wall is the ethmoid bone. This ethmoid bone is actually very thin and is called the lamina papyracea and is usually the part of the orbit that is affected in a fracture (Rho *et al.,* 2021).

The floor of the orbit consists of three bones: the maxillary bone, the palatine bone, and the orbital plate of the zygomatic bone. This part of the orbit is also the roof of the maxillary sinus. There is an infraorbital groove along the floor and it travels into a canal anteriorly where it eventually exits as the infraorbital foramen. The lateral orbital wall is formed by two bones: the zygomatic bone and the greater wing of the sphenoid. This is the strongest of the walls of the orbit (Gossman *et al.,* 2023).

Several openings in the bones of the orbit have anatomic and clinical significance. They include:

1. The bones of the orbit hold and protect the globe and periocular structures
2. It serves as origin points for the extraocular muscles and provide the structure for the fascial and connective tissue elements of the orbit.
3. The optic nerve (CN II) which is the nerve responsible for relaying sight information to the brain travels from the retina, inside of the globe, through the optic foramen of the bony orbit.



Anatomy of the bony orbit (Gerrie *et al.,* 2024).

1.1.2 The Eyelid

The eyelid is a thin fold of skin that covers the ocular surface and protects the eye. When the eye is open, it leaves an almond-shaped aperture known as the palpebral aperture. These "almonds" come to a point called the canthi; the portion nearest to the nose is the inner canthus, and the other is the outer canthus.

The lid may be divided into four layers: the skin containing glands that open onto the surface of the lid margin, and the eyelashes. After that lies a muscular layer containing the orbicularis which contains the orbicularis oculi muscle responsible for lid closure. The eyelids also has a fibrous layer that gives the lid its mechanical stability, its principal portions being the tarsal plates. The innermost layer of the lid consists of a portion of the conjunctiva. The conjunctiva is a mucous membrane that serves to attach the eyeball to the orbit and lids but permits a considerable degree of rotation of the eyeball in the orbit (Doe *et al.,* 2021).

The orbital septum represents the anatomical boundary between the lid tissue and the orbital tissue. The upper eyelid extends superiorly to the eyebrow, which separates it from the forehead. The lower lid extends below the inferior orbital rim to join the cheek, forming folds where the loose connective tissue of the eyelid is juxtaposed with the denser tissue of the cheek (Matsuo *et* *al.,* 2013). The upper eyelid skin crease (superior palpebral sulcus) is approximately 8-11 mm superior to the eyelid margin and is formed by the attachment of the superficial insertion of levator aponeurotic fibers (8-9 mm in men and 9-11 mm in women) (Reid *et al.,* 2006). The inferior eyelid fold (inferior palpebral sulcus), which is seen more frequently in children, runs from 3 mm inferior to the medial lower lid margin to 5 mm inferior to the lateral lid margin.

The eyelids also contain glands that secrete the oily tear film layer that helps in lubricating the ocular surface. These glands are the Meibomian glands and the glands of Zeis and Moll which lie within the eyelid and secretes the lipid part of the tear film. The eyelid contains hairs that grow on the edges of the upper and lower eyelids known as eyelashes. These eyelashes protect the eye from dust, debris and foreign particles (Doe *et al.,* 2021).

The functions of the eyelid are given thus:

1. The eyelid, through the blink reflex, act to protect the anterior surface of the globe from local injury and mechanical trauma.
2. The eyelids protect the eye, serving as a shield from excessive light.
3. In tear film maintenance, eyelids are responsible for distributing the protective and optically important tear film over the cornea during blinking. Periodic blinking helps prevent corneal dryness (and ulceration) by maintaining a homogenous distribution of tear film over the cornea.
4. During sleep, the eyelids cover the eyes and prevent evaporation of the tear film this keeping the surface of the eye, moist.
5. The eyelids and conjunctiva have a rich lymphatic drainage. Active lymphatic drainage has aqueous humor that can drain from the eye to cervical lymph nodes. This process is

vital for maintaining intraocular pressure and can have therapeutic implications for conditions such as glaucoma (Yücel et al., 2015).

1.1.3 The Conjunctiva

The conjunctiva is a smooth, translucent mucous membrane that lines the inside of the eyelids and covers the sclera, playing a role in tear production and eye protection. The palpebral conjunctiva lines the posterior surface of the lids as tarsal conjunctiva (from the mucocutaneous junction of the lid margin to the tarsal plate border) and continues as orbital palpebral conjunctiva into the fornix. This tarsal conjunctiva is adherent to the tarsus, while a submucosal lamina propria underlies orbital palpebral conjunctiva and allows dissection from the vascular Müller muscle. At the depths of the fornixes, the conjunctiva is anteriorly positioned onto the globe as bulbar conjunctiva.

The conjunctiva consists of non-keratinized, stratified squamous epithelium with goblet cells, stratified columnar epithelium and stratified cuboidal epithelium. The thickness of the conjunctival epithelium varies, typically ranging from 3 to 5 cell layers, with a higher concentration of goblet cells located near the fornixes (Takahashi *et al.,* 2013).

The tarsal and orbital conjunctiva has a rich vascular network. The blood supply for the palpebral conjunctiva comes from the vascular arcades of the eyelids. Venous drainage occurs from the small vessels of the eyelid to the conjunctival veins. These veins further drain into the orbital and facial veins. The blood supply to the bulbar conjunctiva is through the palpebral arcades and the anterior ciliary arteries. Lymphatic drainage occurs into the preauricular and submandibular lymph nodes (Steven *et al.,* 2009).

The conjunctiva plays several important roles in maintaining a healthy ocular surface. These include:

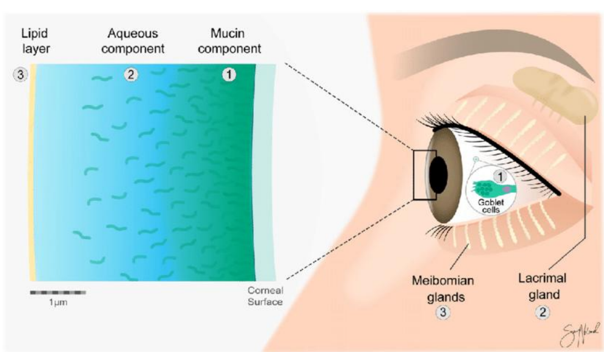
1. The conjunctiva acts as a physical barrier against pathogens, foreign body and debris that comes in contact with the ocular surface.
2. The conjunctival epithelium consists of goblet cells responsible for secreting mucins, which are vital for tear film stability (Shumway *et al.,* 2023).
3. The conjunctiva plays a critical role in ocular immunity and inflammation resolution. It contains conjunctiva-associated lymphoid tissue (CALT), which plays a role in local immune responses. Other immune cells within its structure such as, T- and B-cell lymphocytes, mast cells helps protect against pathogenesis. (Ribatti *et al.,* 2007).
4. The dense capillary network in the sub epithelial lamina helps meet the metabolic demands of the cornea during sleep.

1.1.4 The Tear film

This is a three layered fluid that coats the surface of the cornea epithelium. It smooths out the minute surface irregularities of the corneal surface epithelium. It is often referred to as the pre-corneal tear film and is the first layer of the eye with which light comes into contact and thus play a role in the refraction. The tear film has a volume of 3 to 10 µL and a thickness of 3 µm. It is secreted at a rate of 1 to 2 µL/min. depending on seasonal and diurnal varies. The pH of tears is 7.45 and varies from 7.14 to 7.82 (Dartt *et al.,* 2013). It is a major source of oxygen to the avascular cornea. It is also an immunologically active tissue containing cells such as immunoglobulins, lysozymes, lactoferrin, and α- and β-defensins. The tear film is traditionally told to be composed of three distinct layers. The most superficial layer is composed of oily secretions of Meibomian glands found in the eyelids. Because oil is less dense than water, the secretions float to the top of the tear film to form a smooth refractive surface. A majority of it is secreted by the Meibomian gland while a small amount comes from the Moll and Zeiss glands found in the eyelids. This oily layer also provides an important barrier against the evaporation of the tear film. And lowers the surface tension. (Kels *et al.,* 2015).

The aqueous middle layer of the tear film lies immediately beneath the oily layer. It is produced from the secretion of the lacrimal gland which is located in the superior lateral orbit. The aqueous is secreted onto the ocular surface from ducts in the superior fornix. There are also numerous scattered accessory lacrimal glands of Krause and Wolfring embedded within the conjunctiva stroma which contribute to this aqueous layer. The aqueous layer has a thickness of about 26 μm, and makes up the majority of the tear film thickness (Willcox *et al.,* 2017).

The innermost mucin layer is produced primarily by the conjunctival goblet cells although the epithelial cells of the cornea and the conjunctiva also contribute. The Conjunctival goblet cells seem to be important in performing the functions of debris removal and immune surveillance. The mucin plays a major role in stabilizing and distributing the hydrophilic tear film over the hydrophobic corneal surface and this is necessary for optimal vision (King-Smith *et al.,* 2013).



Anatomy of the tear film (Magno *et al.*, 2021)

1.1.5 The Corneal Epihelium

The cornea is a transparent avascular tissue that acts as a structural barrier and protects the eye against infections. Along with the tear film, it provides proper anterior refractive surface for the eye. Cornea contributes to two-third of the refractive power of the eye. The cornea is horizontally oval, measuring 11–12 mm horizontally and 9–11 mm vertically (Ruger *et al.,* 2005).

The Cornea is a bi convex and aspheric. Its anterior curvature is 7.8 mm and posterior curvature is about 6.5 mm. As the major refractive tissue of the eye, it contributes to about 40–44 D of refractive power and accounts for approximately 70% of total refraction eye (Baylen, 2022). The cornea is made up of cellular and acellular components. The cellular components include the epithelial cells, keratocytes and endothelial cells. The acellular component includes collagen and glycosaminoglycans. The epithelial cells are derived from epidermal ectoderm. The keratocyte and endothelial cells are derived from neural crest. The corneal layers include epithelium, Bowman's layer, stroma, Descemet's membrane and endothelium. A new layer has been discovered just before the endothelium, after the Descemet's membrane, known as Dua's Layer (Dua *et al.,* 2013).

The corneal epithelium is composed fairly uniformly of 5–7 layers of cells. It is about 50 μ in thickness. The epithelium is uniform to provide a smooth regular surface and is made up of non-keratinized stratified squamous epithelium. The epithelium is derived from surface ectoderm between 5 and 6 weeks of gestation (Sridhar *et al.,* 2018).

The epithelium is made up of three types of cells: superficial cells, wing cells, and the basal cells. The superficial cells are 2–3 layers made up of flat polygonal cells. They have a diameter of 40–60 μ with a thickness of about 2–6 μ. The microvilli on the surface increase the surface area.

Desmosomes form the tight junction in between the superficial cells. Thawing cells are 2–3 layered and are named thus, as they have wing-like shape. They express 64-k dalton keratins. Basal cells are single layer of the epithelium which is cuboidal or columnar (Farjo & Soong, 2009). They have abundant organelles and they are active mitotically. The surface cells maintain tight junction complexes between the neighbors which prohibit tears from entering the intercellular spaces. The deepest cell layer of the epithelium is the basal layer, which compromises the single cell layer of epithelium approximately 20 μ tall. Besides the stem cells and transient amplifying cells, basal cells are the only corneal epithelial cells capable of mitosis. They are the source of wing and superficial cells.

The epithelium and the overlying tear film have a symbiotic relationship. The mucin layer of the tear film which is in the direct contact with corneal epithelium is produced by the conjunctival goblet cells. It interacts closely with the corneal epithelial cells' glycocalyx to allow hydrophilic spreading of the tear film with each eyelid blink

1.1.6 The Sclera

The sclera, also known as the white of the eye or, in older literature, as the tunica albuginea oculi, is the opaque, fibrous, protective outer layer of the eye containing mainly collagen and some crucial elastic fiber (Girard *et al.,* 2020). It forms the posterior five-sixths of the connective tissue coat of the human eyeball. At its anterior boundary, the sclera merges with the corneal perimeter at the limbus and extends backward to form an approximate sphere of vertical diameter ~24mm (Kumar *et al.,* 2024). The axial length of the emmetropic adult human eye is 24–25mm.The thickness of the sclera varies from 1 mm at the posterior pole to 0.3 mm just behind the insertions of the four rectus muscles. The sclera's blood vessels are mainly on the surface.

The collagen of the sclera is continuous with the cornea. From outer to innermost, the four layers of the sclera are: episclera, stroma, lamina fusca and endothelium.

In the development of the embryo, the sclera is derived from the neural crest (Shubert *et al.,* 2009). In children, it is thinner and shows some of the underlying pigment, appearing slightly blue. In the elderly, fatty deposits on the sclera can make it appear slightly yellow. People with dark skin can have naturally darkened sclera, the result of melanin pigmentation.

The sclera functions to maintain the shape of the eyeball, offering resistance to internal and external forces, and providing an attachment for the extraocular muscle insertions. The sclera is perforated by many nerves and vessels passing through the posterior scleral foramen, the hole that is formed by the optic nerve. At the optic disc, the outer two-thirds of the sclera continues with the dura mater (outer coat of the brain) via the dural sheath of the optic nerve. The inner third joins with some choroidal tissue to form a plate (lamina cribrosa) across the optic nerve with perforations through which the optic fibers (fasciculi) pass.

The sclera is opaque due to the irregularity of the Type I collagen fibers, as opposed to the near-uniform thickness and parallel arrangement of the corneal collagen. Moreover, the cornea bears more mucopolysaccharide (a carbohydrate that has among its repeating units a nitrogenous sugar, hexosamine) to embed the fibrils. Sometimes, very small gray-blue spots can appear on the sclera, a harmless condition called scleral melanocytosis.

1.1.7 Severity of ocular injuries

The quantification of the severity of ocular injury is one that has been an ongoing area of interest in research. Models for assessing severity based on anatomical damage or functional loss has been previously proposed (Kuhn *et al.,* 2002, Blakeslee *et al.,* 2002, Shukla *et al.,* 2017).

However, grading the severity of ocular injuries has mostly remained a subjective process. While pediatric ocular trauma score can be used to determine severity, it mostly serves as a diagnostic tool and does not paint the full picture.

The trauma index was first introduced in 1983 by Shukla. This is a combination of all the important factors considered in quantifying severity. The trauma index is a function of the structural loss, functional loss and the time taken to recover from the ocular injury.

For most ocular injuries, maximum damage occurs at the time of trauma. However, in some cases, the effects have a late onset and need a long follow up. The magnitude of trauma depends on the structural and functional loss it induces with respect to the time factor which implies approximate recovery time (Shukla *et al.,* 1987, as cited in Shukla *et al.,* 2017).

Although the structure and function of the eye are almost equally important, from the economical, occupational and medico legal point of view the loss of function has much greater significance than the loss of structure alone (Yadav *et al.,* 2016). Hence in evaluation of trauma the structural loss has been halved in calculation.

The trauma index is thus given by the formula below;

Trauma Index (T.I.= 1/2 (S/2 + F) x T/ 100

S - Structural loss and is graded as mild (25%), moderate (50%) and marked (100%). Marked loss includes cases of large scleral or corneo-scleral tears, total anterior staphyloma, phthisis bulbi, multiple fractures leading to gross displacement of the globe. Moderate loss included dense corneal and lenticular opacities, ptosis or lagophthalmos, squint, marked sub conjunctival hemorrhages and hyphemia and acute inflammations. Mild loss included slight corneal and lenticular opacities, scar or notching of lids, slight con-gestion, swelling, hemorrhage etc. This judgement is not watertight and is based on the discernment of the clinician (Shukla *et al*., 1987, as cited by Shukla *et al.,* 2017).

F - Functional loss and is graded from 0 the 100% depending on the visual acuity (6/6 to N.L.P.).

Loss up to 6/60 is graded in steps of 10 and beyond that in steps of 5. This is based on the presumption that pre-trauma vision was 6/6 which is perhaps true in most cases.

The score obtained from the calculation of the trauma index gives the severity of the ocular injury.

- A trauma index score of 0-10= mild injury
- A trauma index score of 11-50=moderate injury
- A trauma index >50=highly severe

TABLE 1.1: Post trauma functional Visual Acuity Loss in Meters and the equivalent percentage (Shukla *et al.,* 2018).

POST TRAUMA VA (METERS)	EQUIVALENT %	POST TRAUMA VA (METERS)	EQUIVALENT %
6/6	0	6/75	65
6/9	10	6/95	70
6/12	20	6/120	75

6/18	30	6/150	80
6/24	40	6/190	85
6/36	50	C.F/H.M	90
6/60	60	L.P	95
		NLP	100

N.L.P: No Light Perception, L.P: Light Perception, C.F: Counting Finger, H.M: Hand Movement

In the formula for Trauma Index, T stands for the time factor which indicates approximate time for recovery.

TABLE1.2: Time taken for the patient to recover and the equivalent percentage (Shukla *et al.,* 2018).

RECOVERY TIME	EQUIVALENT %	RECOVERY TIME	EQUIVALENT %
Less than 1 day	0	1 month	50
1 day	5	2 months	65
2 days	10	4 months	70
3 days	15	6 months	75
4 days	20	8 months	80
5 days	25	10 months	85

1 week	30	1 year	90
2 weeks	35	5 years	95
3 weeks	40	10 years or more	100

1.1.8 Treatment and management of ocular injuries

The treatment modality for ocular injuries depends on the form of injury, magnitude of the injury and causative factor. In order to determine these parameters, proper case history should be swiftly taken. Information about anything that hit the eye, what the patient was doing when the eye was injured and if any first aid treatment was given, should be obtained (Rho *et al.,* 2021). For young children or unconscious patients - history should be gotten from a witness.

In cases of chemical ocular injures which is a true ocular emergency, the first line of action is utilization of the three "Is" IRRIGATE, IRRIGATE AND IRRIGATE (Ikeda *et al.,* 2006). Ideally, irrigation of the affected eye should be done as soon as possible in an eyewash or shower station with sterile saline solution in order to reduce the chances of further damage to the eye. If sterile saline is not available, cold tap water can also be used to dilute the agent. The patient must try to open the eyelids as wide as possible to obtain the best irrigation. However, when one is in pain, he may find it difficult to keep the eyes open. Hence, a wire lid speculum can also be used to assist in eyelid retraction. Topical antibiotics, pain relief, and tetanus immunization are required for all ocular burns. Some chemical and thermal burns may require non preserved lubricants. Adequate lubrication helps to prevent the formation of symblepharon (ie adhesions of the eyelid to the eyeball) (Iyer *et al.,* 2019).

Ascorbic acid may promote collagen production. After alkali burns, the level of ascorbic acid decreases. Some researchers have demonstrated that topical administration of 10% ascorbic acid may reduce corneal perforation. At present, however, this treatment is being used only experimentally and may be recommended by ophthalmologists. Oxygen therapy was studied and showed faster corneal epithelial defect healing and quicker vascularization of ischemic areas, although vision outcomes were not reported (Sharifipour *et al.,* 2011).

Corneal foreign bodies can be removed after adequate topical anesthesia under magnification with good illumination (Khaw *et al.,* 2004). A finger nail or even an eyelash can cause a corneal abrasion which can be examined once topical anesthetic has been instilled. Staining with flourescein dye will indicate an epithelial defect. The corneal epithelium can regenerate on its own, within 24 hours of the abrasion. Therefore, management involves administering an antibiotic ointment to prevent opportunistic infections (Mutie & Mwangi et al., 2015).

Eyelid involvement is common in facial burns (Malhotra *et al.,* 2009). Lid lacerations are managed differently depending on the injury's depth, width, and location. Surgical management is broken down into these categories: laceration without eyelid margin involvement, laceration with eyelid margin involvement, and laceration with nasolacrimal system involvement (Cochron *et al.,* 2022). Simple lacerations can be sutured. Septic lacerations should be cleaned and then treated with systemic antibiotics. Delayed primary closure may be advisable in this case. Lacerations involving the lid margins should also be referred to a specialist who can close the lid margins with fine precision. Medial canthus injuries should be assessed to see if there is a tear of the lower canaliculus (a lacrimal probe can be used). If damaged, the patient should be referred to an eye specialist for canaliculi repair. Ocular sequelae, including corneal ulceration, are usually preventable and secondary to the development of eyelid deformities, exposure keratopathy, and rarely, orbital compartment syndrome.

A sub-conjunctival hemorrhage is quite common after trauma and can be managed conservatively (Cagini *et al.,* 2016). However, occasionally it can be the only sign of a ruptured globe, when it may be associated with a low intraocular pressure (IOP) and an abnormally deep anterior chamber. Blood in the anterior chamber is called hyphemia. It usually follows a blunt injury and results from tearing of the iris. The pupil may be dilated. Most hyphemia clear within five to six days with conservative treatment which may sometimes include bed rest, topical atropine sulfate drops and topical corticosteroids, as well as measures to prevent re-bleeding (Tripathi *et al.,* 2015). The sight-threatening complications of hyphemia are caused by raised IOP, which is managed by oral acetazolamide (Diamox). Surgical washout of a hyphemia is very rarely required and carries particular risks such as re-bleeding and should only be resorted to for specific indications. These include: corneal staining from persistent hyphemia (Tripathi *et al.,* 2015).

If the eye is blind to light and painful, then removal should be considered (Soares *et al.,* 2010). Evisceration may be more appropriate (for non-malignant conditions) in developing countries, because the procedure is simpler than enucleation, the results offer better cosmetic results and there is less danger of systemic infection if the eye is infected. However, it is thought to carry a risk of sympathetic ophthalmia (Ababneh *et al.,* 2015).

1.2 STATEMENT OF PROBLEM

Nigeria has one of the largest growing populations in the world, with over 228 million people. A remarkable large fraction of this population are children under 18 years old (110 million) (United

Nations International Children Emergency Fund, 2024). One of the leading causes of unilateral blindness in children is ocular injury and this can be a major cause of emotional distress and lifelong disability.

Most studies published on the subject of pediatric ocular injuries have predominantly focused on the epidemiology, etiology of specific injuries (such as corneal lacerations and open globe injuries), gender- related factors, and occurrence of pediatric injury. There is still a paucity of data on the severity of pediatric eye injury and the management protocol in handling these cases and their visual outcomes. In order to develop effective treatment protocols, it is crucial to first understand the current trends in prevention and treatment.

1.3 AIM AND OBJECTIVE

1.3.1 Aim of study

The aim of the study is to investigate the severity and management of pediatric ocular injury in Central hospital, Sapele, Delta state.

1.3.2 Objectives of study

The objectives of the study are:

1. To determine the severity of ocular injuries in Central hospital, Sapele.
2. To determine the relationship between age group and the severity of ocular injuries in Central hospital, Sapele.
3. To determine the relationship between gender and the severity of ocular injuries in Central hospital, Sapele.
4. To determine the first aid treatment/initial drug used by the patients of pediatric population before they present to the Optometric section in Central hospital, Sapele

5. To determine the medications used in the medical management of ocular injuries in children in Central hospital, Sapele.
6. To determine the structures of the eye affected in pediatric ocular injury.
7. To determine the average time taken to recover from pediatric ocular injuries

1.4 RESEARCH QUESTIONS

1. Is there a statistically significant relationship between gender and the severity of ocular injuries among the pediatric population in Central hospital, Sapele?
2. Is there a statistically significant relationship between the age group and the severity of ocular injuries in the pediatric group in Central hospital, Sapele?
3. What are the first aid protocol or initial treatment protocols used by the general population in the advent of an ocular injury in the pediatric population in Sapele, Delta State?
4. What is the distribution of the ocular tissues affected by ocular injuries in the pediatric population in Central hospital, Sapele?
5. What are the treatment protocols initiated in the management of pediatric ocular injury in Central hospital, Sapele?
6. What is the average time it takes a pediatric patient to recover from an ocular injury in Central Hospital, Sapele?

1.5 SIGNIFICANCE OF STUDY

1. This study would help enrich the course content in the field of environmental Optometry
2. This study would help to improve the basis of data for research into the field of ocular injuries in the pediatric population.

3. This study would help in the presentation and overall management of pediatric ocular injuries.
4. This study would aid public health and allow for the development of strategies to reduce the socio-economic burden of ocular trauma on health care systems and the community.

1.6 DEFINITION OF TERMS

1. **Evisceration**- This is a surgical procedure in which the contents of the eyes are removed, leaving the Sclera (the white outer shell of the eye) and sometimes the Cornea intact.
2. **Hazards**- These are potential source of harm or adverse effects to people, property or the environment. They are conditions or situations that cause injury, illness, damage or loss if not mitigated.
3. **Ectoderm-** This is one of the three primary germ layers during embryonic development in animals, including humans. It is the outermost layer and gives rise to the various structures and tissues in the body.
4. **Malnutrition**- This is a condition where the body does not receive the right nutrients needed to maintain health and proper functioning. It can also result from an excess of nutrients and it affects people of all ages.
5. **Communicable disease**- This is an illness caused by an infectious agent such as a Bacteria, Virus, Parasite, Fungi that can be transmitted from one person to another, from animals to humans, or through the environment.
6. **Mortality-** This is the incidence of death within a population over a specific period of time.
7. **Morbidity**-This refers to the presence of an illness, disease or disability in a population.

8. **Irrigation-** This is the process of flushing the eye with a sterile solution, usually Saline in order to remove debris, foreign bodies or harmful substances from the ocular surface.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Classification of ocular injuries

An injury is a damage/trauma to an individual or to an organ/tissue such as the eye, caused by the transfer of any form of energy. An eye injury, therefore, includes all damages caused to the eye and its adnexa because of direct contact with fixed or mobile, blunt or sharp, or hot object, chemical substances; sources of electrical power; or different types of radiations (ultraviolet rays, x-rays, microwave).

Ocular injuries can be divided into three main types:

1. Non-mechanical injuries (chemical/thermal injuries)

2. Non-globe injuries (orbital/adnexal injuries)

3. Mechanical injuries

2.1.1 Non-mechanical injuries

1. Chemical injuries

Ocular burns consist of burns to the sclera, conjunctiva, cornea, and eyelids. Chemical burns, particularly those involving the cornea, are considered a true ophthalmologic emergency and require prompt assessment and intervention to minimize morbidity. These injuries occur as a result of acid, alkali, or neutral agents, with alkalis being responsible for 60% of all injuries (Bizrah *et al.,* 2019). The common causes of acid injury are from household cleaners like bleach, car batteries which contain sulfuric acid and even swimming pools which are a source of hydrochloric acid. For alkali injury, fertilizers which contain ammonia, potassium hydroxide (potash), sodium hydroxide (drain cleaners, car airbags), magnesium hydroxide (sparklers, flares) and lye (plaster, mortar, cement, and whitewash) are some of the major causes.

Alkali agents are lipophilic and therefore penetrate tissues more rapidly than acids. This is due to the inability of the ocular tissues to buffer alkali. They saponify the fatty acids of cell membranes, penetrate the corneal stroma and destroy proteoglycan ground substance and collagen bundles. The damaged tissues then secrete proteolytic enzymes, which lead to further damage. This is termed liquefactive necrosis. Irreversible damage occurs at a pH value above 11.5 (Bunker *et al.,* 2014).

Acids are generally less harmful than alkali substances. For one, acids have lower than normal pH values of the human eye (7.4) hence they precipitate tissue protein, creating a barrier to further ocular penetration. Thus, acid injuries tend to be less severe than alkali injuries. However, there is one exception in hydrofluoric acid, which may rapidly pass through cell membranes and enter anterior chamber of the eye. This acid reacts with collagen resulting in shortening of collagen fibers which cause a rapid increase in intraocular pressure (IOP) (Bizrah *et al.,* 2019).

There are two major classification schemes for corneal burns. This are the Roper-Hall (modified Hughes) classification and the Dua classification

The Roper-Hall classification is based on the degree of corneal involvement and limbal ischemia (Merle *et al.,* 2008). The prognosis depends on the depth of the injury. Corneal burns are classified into 4 grades by the Roper Hall scale, as follows:

1. Grade 1 - Only corneal epithelial loss is present, and no conjunctival ischemia is found; the prognosis is very good

2. Grade 2 - Some corneal edema and haze are present, and the conjunctival ischemia affects less than one third of the limbus; some permanent scarring may occur
3. Grade 3 - The cornea has significant haziness, and limbal ischemia is less than one half of the limbus; the prognosis is variable, and vision usually is impaired
4. Grade 4 - The cornea is opaque, and limbal ischemia is greater than one half of the limbus, with a possibility of globe perforation; the prognosis is poor

Grade	Prognosis	Limbal ischemia	Corneal involvement
I	Good	None	Epithelial damage
II	Good	Less than 1/3	Corneal haze, iris details visible
III	Guarded	1/3 to 1/2	Total epithelial loss, stromal haze, iris details obscured
IV	Poor	Over 1/2	Cornea is opaque, iris and pupil are obscured

The Roper Hall classification of Corneal Injuries. (Radosavljevic *et al.,*2014).

The Dua classification is based on an estimate of limbal involvement (in clock hours) and the percentage of conjunctival involvement (Dua *et al.,*2001). Dua *et al* subdivides the grade 4 of Roper Hall as follows:

1. Grade 1 - 0 clock hours of limbal involvement; 0% conjunctival involvement; prognosis is very good
2. Grade 2 - ≤3 clock hours of limbal involvement; ≤30% conjunctival involvement; prognosis is good

3. Grade 3 - >3-6 clock hours of limbal involvement; >30-50% conjunctival involvement; prognosis is good
4. Grade 4 - >6-9 clock hours of limbal involvement; >50-75% conjunctival involvement; prognosis is good to guarded
5. Grade 5 - >9 to < 12 clock hours of limbal involvement; >75% to < 100% conjunctival involvement; prognosis is guarded to poor
6. Grade 6 - Total limbal involvement; total conjunctival 100% involvement; prognosis is very poor

Grade	Prognosis	Clinical Findings	Conjunctival Involvement	Analogue Scale
I	Very good	0 clock hours of limbal involvement	0%	0/ 0%
II	Good	≤ 3 clock hours of limbal involvement	≤ 30%	0.1–3 / 1– 29.9%
III	Good	3 - 6 clock hours of limbal involvement	30 - 50%	3.1–6 / 31– 50%
IV	Good – guarded	6 - 9 clock hours of limbal involvement	50 – 75%	6.1–9 / 51– 75%
V	Guarded – poor	9 - <12 clock hours of limbal involvement	75 - < 100%	9.1–11.9 / 75.1– 99.9%
VI	Very poor	Total (12 clock hours) limbal involvement	100%	12 / 100%

Dua's classification and grading of corneal injury (Willmann *et al.,* 2023).

In a randomized controlled trial of acute burns, the Dua classification was found to be superior to the Roper-Hall in predicting outcome in severe burns (Gupta *et al.,* 2011).

2. Thermal Injuries

Thermal burns in general can be both life threatening and sight threatening. The most common structures affected are the eyelid and the periocular area. However, the loss of an eye and vision primarily from a thermal injury is uncommon, primarily due to a significant number of inherent protective mechanisms such as the blink reflex, Bell's phenomenon, and protective movements of the head and arms to avoid the source of a burn (Al-Mahdi *et al.,* 2020).

The most common causes of burn injury are fire/flame and hot water (scald), with scald burns being a particular problem in children. A burn injury results in the release of multiple inflammatory mediators that result in vasodilatation, pain, and edema. The depth of burn depends on the intensity of heat exposure, the duration of exposure, and the thickness of epidermis and dermis. Since the eyelid is thin and without subcutaneous fat, deeper burns may occur compared to similar exposure to skin elsewhere (Al-Mahdi *et al.,* 2020).

The three zones of a burn were described by Jackson et al in 1947(Diao *et al.,* 2018).

A. **Zone of coagulation**—This occurs at the point of maximum damage. In this zone there is irreversible tissue loss due to coagulation of the constituent proteins.

B. **Zone of stasis**—The surrounding zone of stasis is characterized by decreased tissue perfusion. The tissue in this zone is potentially salvageable. Thus the main goal of burn resuscitation is to increase tissue perfusion and minimize irreversible damage. Additional insults, such as prolonged hypotension, infection, or edema, can convert this zone into an area of complete tissue loss.

C. **Zone of hyperemia**—In this outermost zone, tissue perfusion is increased. The tissue here will invariably recover unless there is severe sepsis or prolonged hypoperfusion.

Based on this system, ocular adnexal burns may be classified depending on the extent, depth and severity of the injury including underlying tissue damage.

A. **First degree burns / Epidermal burns-** This corresponds to the zone of hyperemia in Jackson's model. Severe sunburn is the most common example of first-degree burn. By definition, this affects only the epidermis, and blistering is not common. Pain is due to the inflammatory response and the local vasodilator prostaglandins. For first degree burns, healing is usually complete within a week.

B. **Second degree burns-** These are known as partial-thickness burns involve the dermis and epidermis. This corresponds to the zone of stasis in Jackson's model. It is commonly divided into superficial and deep dermal injury. Injury to the epidermis and superficial papillary dermis results in thin-walled, fluid-filled blisters with a moist red base. The exposure of superficial nerves makes these injuries painful. A burn of this depth usually heals within 2 weeks by regeneration of epidermis from keratinocytes within sweat glands and hair follicles, with minimal scarring. In contrast, dermal burns have a pale white or mottled base beneath the blisters. The healing takes three or more weeks, and is accompanied by scarring and contraction. These injuries are of concern in the eyelid region, often necessitating early surgery for contraction and eyelid retraction (Hettiaratchy *et al.,* 2004).

C. **Third degree burns / Full-thickness burns-** These destroy epidermis, dermis, and all regenerative elements and correspond to the zone of coagulation in Jackson's burn wound model. The skin is dry, leathery, and as a result of heat coagulation of dermal blood vessels, the affected tissue is avascular and white. Such burns are typically painless due to loss of sensation in the involved area. Healing only occurs from the edges and is associated with significant contraction. Early excision of affected tissue and skin grafting is almost always required to resurface the burnt area and prevent secondary severe corneal complications from exposure and secondary infection.

D. **Fourth degree burns / Deep burns-** These are full-thickness burns with destruction of the underlying muscle, bone and vital structures. Such burns require extensive and complex multidisciplinary management and often result in severe contracture and prolonged disability.

3. Electrical Injuries

Lighting and high tension electrical appliances are the two main causes of electrical injuries. Current passing from the head, hair, eyebrows and the lashes will result in superficial lid burns giving rise to edema and conjunctival chemosis. There may be corneal cloudiness due to interstitial opacities and edema (electrical injuries, n.d.).

4. Radiation Injuries

Lots of charges make injuries possible when ocular tissues are exposed to ionizing radiations. Sensitivity of the ocular tissue depends on the motility activity of the cell [i.e. cell division and growth] and its ability to repair radiation induced damage. The lens is the most sensitive followed in decreasing order by the conjunctiva, cornea, vitreous, iris and uveal tract, sclera and retina (Waslenko *et al.,* 2004)

2.1.2 Non Globe Injuries

These include orbital fractures, lid lacerations and retrobulbar hemorrhage. The most common causes of orbital fractures in the pediatric age group are motor-vehicle accidents, sports, and falls, with falls being the most common in children younger than 5 years and sports injuries in children older than 5 years (Kavak *et al.,* 2020). Changes in the skeletal and facial architecture as a child develops lend to certain fractures being more or less common. In infancy, the larger brow protects the face, then as the child grows, the midface and mandible become more prominent and are more likely to become injured. This renders younger patients more likely to sustain orbital rim fractures, whereas older children and adolescents are more likely to have medial, lateral, and floor fractures (Hink *et al.,* 2014).

Patients with facial fractures related to trauma are at an increased risk for associated eye injuries. The presence of surrounding periorbital soft-tissue swelling and other associated injuries may make physical examination of the globe may be challenging during acute trauma. This, coupled with difficulties related to the patient cooperation caused by sedation, unresponsiveness, altered state of mind prompted the development of imaging techniques. Various imaging techniques, which are used in ocular adnexal trauma as follows: Ultrasonography (USG), Ultrasound Biomicroscopy (UBM), Optical coherence tomography (OCT), Fundus Fluorescein Angiography (FFA), Indocyanine Green Angiography (ICG), Fundus Auto Fluorescence (FAF), Fundus Auto Fluorescence (FAF), Plain x-ray and Computerized Tomography (CT scan) and Magnetic Resonance Imaging (MRI) (Moin *et al.,* 2023).

Conventional A & B scan ultrasonography, along with high frequency ultrasound biomicroscopy, optical coherence tomography, fundus fluorescein and indocyanine green angiography and fundus autofluorescence play a crucial role in diagnosis and monitoring intraocular injuries. Meanwhile imaging techniques such as plain x-ray, computerized tomography (CT) and Magnetic Resonance Imaging (MRI) are primarily utilized for assessing the orbit, optic nerve and ocular adnexal injuries (Fenton *et al.,* 2021).

Computerized tomography is the preferred imaging modality for evaluating suspected orbital and orbitofacial fractures, intraorbital and intraocular foreign bodies and traumatic optic neuropathies. In the trauma setting, CT is typically performed without contrast, except when there is concern for a carotid-cavernous fistula. Axial CT images are particularly valuable in assessing the medial and lateral orbital walls, as well as the medial and lateral rectus muscles (Murray *et al.,* 2023).

When orbital wall fracture, CT scan can effectively identify entrapped extraocular muscles. These scans often reveal linear floor fractures with minimal displacement and little or no soft tissue displacement in the maxillary antrum. However, associated soft tissue swelling, fat stranding, and muscular hematoma can complicate radiographic interpretation. This is especially true in pediatric patients where signs of extraocular tissues entrapment on CT may be subtle. Therefore a thorough clinical examination-through the evaluation of extraocular motility and forced ductions remains essential for accurate diagnosis.

Cone Beam CT scans (CBCTs) may be considered in special situations either as a screening tool for bony injuries or as a postoperative evaluative tool following orbit facial trauma repair especially with radiopaque implants. Magnetic resonance imaging [MRI] has a limited role in ocular and ocular adnexal trauma and hence rarely indicated in the acute posttraumatic situation (Amano *et al.,* 2022)

- **Eyelid lacerations**- this may refer to partial- or full-thickness defects in the eyelid constitute a significant subset of facial trauma which is often accompanied by other ocular injuries including corneal abrasions, disruption of the lacrimal drainage system, foreign bodies, open globe, or orbital fractures. As lid damage may be associated with serious ocular injury not apparent on initial exam, lacerations or other injuries to lid structures should prompt a thorough investigation to exclude potentially serious underlying ocular pathology (Patel *et al.,* 2023).

Lid lacerations occur as a result of two general mechanisms including; contact with sharp objects moving at high velocities that either penetrate superficial structures (skin, subcutaneous tissues) and result in a partial-thickness defect or one that penetrate deeper structures (posterior layers, tarsus, conjunctiva) resulting in a full-thickness defect and avulsion injuries from blunt trauma (Morris *et al.,* 2022). Most children and young adults suffer these injuries typically from dog bites, falls, handlebar injuries, and collisions with sharp objects. Adolescents and adults however, suffer lid lacerations from blunt trauma from fists, motor vehicle accidents, eye gouging, and ball sports (Morris *et al.,* 2022).

2.1.3 Mechanical Globe Injuries- the Birmingham Eye Trauma Terminology System (BETTS)

Mechanical globe injuries are a type of eye injury that can range from superficial abrasions to vision-threatening damage. They can be open or closed. In time past, the terms used for the determination of the type of injury suffered by a patient was diverse and dependent on the discretion of the attending doctor (Kuhn *et al.,* 2004). Terms such as, blunt injury, contusion rupture, blunt penetrating trauma, sharp laceration were used (Kuhn *et al.,* 2004). While the attending physician may understand what he means, such case report may be very difficult to interpret by other colleagues. Lacking a standardized terminology of eye injury types, it is impossible to fulfil a very basic requirement of medicine: that all communications be unambiguous (Kuhn *et al.,* 2004). This prompted the development of the Birmingham Eye Trauma Terminology System (BETTS). The Birmingham Eye Trauma Terminology classification system has been used in numerous studies in order to classify ocular trauma (Boret *et al.*, 2020, Cai *et al.,* 2015, Puodziuviene *et al.*, 2021)

Under the BETTS, mechanical injuries can be classified into injuries to the eye wall, as well as open or closed globe injuries.

1. **Eyewall-** This particularly refers to the sclera and cornea. Anatomically, the eyeball has three coats posterior to the limbus (Remington, 2012). However, for clinical and practical purposes only violation of these external structure i.e. the cornea and sclera, is taken into consideration.
2. **Closed Globe Injury[CGIs]-** This occurs as a result of direct and indirect contusion forces, which leaves the cornea and sclera remain largely intact, while other eye structures of anterior and posterior segment can be significantly damaged. CGIs are thus known as non-penetrating injuries. Closed globe injuries are an important cause of acquired visual impairment and monocular blindness in childhood age that can lead to a variety of social and economic results (Heath *et al.,* 2022). Common characteristics of closed globe injuries include, accidental occurrence, single eye involvement, and preventable trauma. CGIs can be divided into contusion injuries and lamellar laceration.

a. **Contusion-** Contusion is the medical term for a bruise. It is the result of a direct blow or an impact, such as a fall and is generally caused by a blunt object (Kuhn *et al.,* 2004). Contusions are common in sports injuries. Sporting equipment such as a paddle, tennis or golf ball that hits at a high-speed the eye surface and may damage several structures. Damages may include: Iris sphincter ruptures, which is the rupture of the muscle that brings about pupillary contraction. In patients suffering such rupture, the pupil may remain dilated or deformed for life, which may cause permanent discomfort to light, known as photophobia. There may be Inflammations or uveitis, termed traumatic uveitis. The intraocular pressure of the eye may drastically increase to levels that may even damage the optic nerve and cause glaucoma. In other cases, patients may also suffer from a cataract secondary to this kind of injury, and such cataract may fall into the retinal cavity. This phenomenon is known as lens luxation.

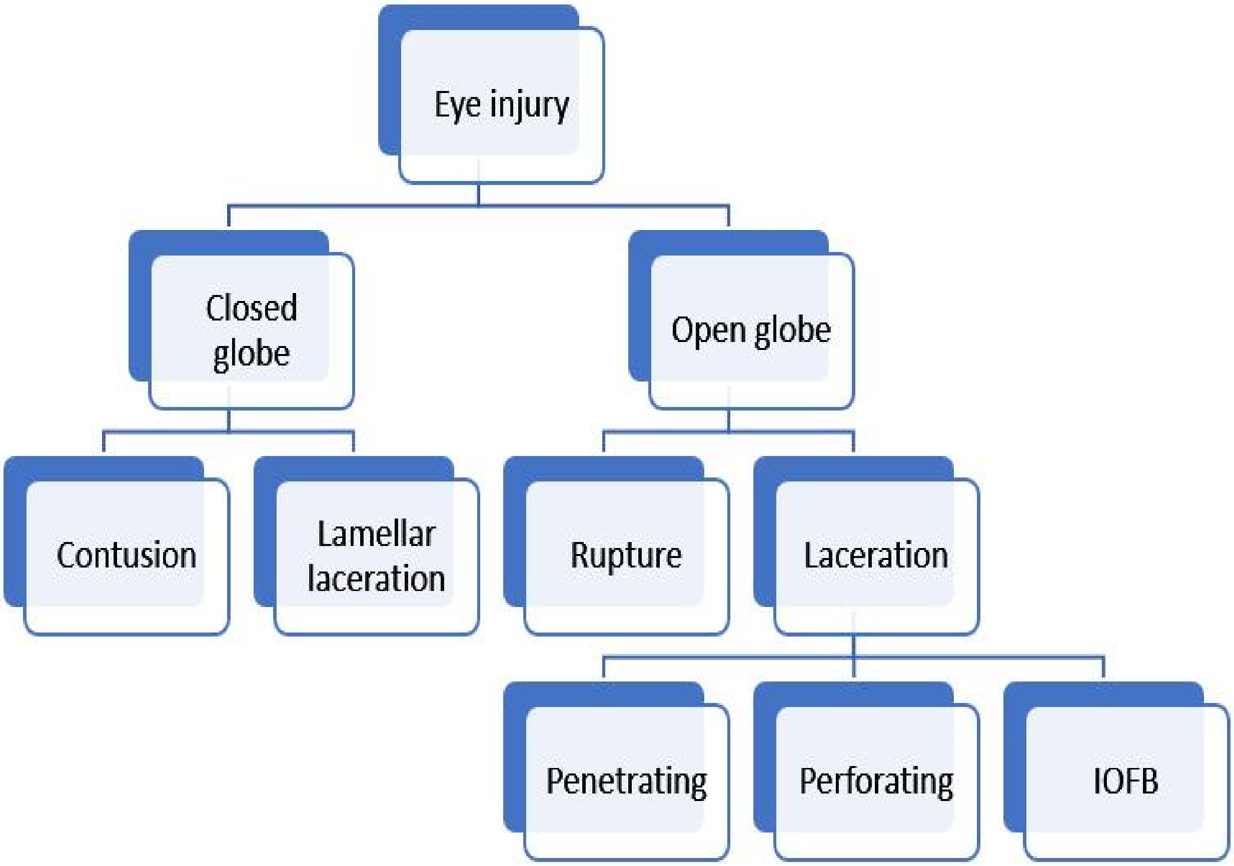
b. **Lamellar laceration**- This is a partial thickness injury of the eye wall (generally caused by a sharp injury) or tear of the cornea or sclera of the eye that can occur after an injury. Here, the wound of the eyewall is not through but rather into the eye (Kuhn *et al.,* 2004).

3. **Open Globe Injury [OGIs]-** These are full thickness injuries and also known as penetrating injuries. It is an ocular emergency that may lead to permanent visual loss if prompt action is not taken. Major causes of OGI include; knife wounds, Road Traffic Accident (RTA), shrapnel and other flying debris, explosions, fishing hooks etc. It may occur in anyone however OGIs are more likely to occur in males. An OGI may be described as secondary to blunt trauma or due to a laceration (Moharana *et al.,* 2022). It includes globe ruptures, lacerations, penetrations, or perforations (Kuhn *et al.,* 2002). It may induce symptoms of flat anterior chamber, lowered intra-ocular pressure, bloody chemosis, and an irregular pupil.

a. **Globe Rupture**- This is a full-thickness injury of the eyewall by a blunt object. The eye which is filled with media such as aqueous and vitreous, thus the impact of such object may result in momentary increase of the intraocular pressure. The eyewall yields at its weakest point; usually where the sclera is thinnest and weakest near the equator directly behind the rectus muscles. Other regions prone to rupture include the limbus, insertion of the optic nerve through the lamina cribosa and sites of prior eye surgery such as, an old cataract wound which dehisces even though the impact occurred elsewhere. Once a ruptured globe injury occurs, it may result in diffuse injury, hemorrhagic choroidal and retinal detachment leading to a long and vigorous healing process(Joussen *et al.,* 2020). The wound is thus produced by an inside-out mechanism (Kuhn *et al.,* 2004).

b. **Laceration-** This is a full-thickness injury of the eyewall caused by a sharp object with the wound occurring at the impact site by an outside in mechanism (Kuhn *et al.,* 2004). Laceration injuries can be divided into a penetrating wound and an intraocular foreign body;

- **Penetrating injury-** This is a single laceration of the eye wall with no exit wound. If there is more than one entrance wound then it must be from a different agent (Kuhn *et al.,* 2004)
- **Intra-ocular foreign body-** This refers to retained foreign objects within the eye caused by an entrance laceration. Technically, they can be seen as penetrating injuries. However 5they have a different clinical outcome (Kuhn *et al.,* 2004).



Birmingham Eye Trauma Terminology System (Sao *et al.,* 2022).

2.2 Etiology of ocular injuries

Ocular trauma that leads to visual loss is a significant problem in a pediatric patients (Zungu *et al.,* 2021). The causes of injury varies in different geographical area and age group (Pardhi *et al.,* 2015). Younger children are more prone to an irresponsible behavior and lack of appreciation of potential hazards and areas of harm. This is because they are more active and more exposed to outdoor activities and sometimes even involved in childhood labor especially in developing countries and rural communities. Accidental fall injuries are more common among younger age groups <5 years while projectile objects and sports injuries are more common in older children

(Pardhi *et al.,* 2015). Pediatric ocular injuries can therefore result from a variety of causes, including accidents, sports injuries, child abuse, and exposure to harmful substances. Some of these include;

1. Physical abuse and neglect: Pediatric ocular trauma during the pandemic and in the post pandemic world has seen a rise due to the added stresses on caregivers. Parents are fast losing their sources of income, there is more social isolation and many families are facing dramatically heightened levels of stress. Along with this added stress comes increased risk of child abuse and neglect. On average, the percentage of hospital visits related to child abuse and neglect ending in hospitalization has increased significantly among children and adolescents under 18 years. (Swedo *et al.*, 2020). A direct consequence of this neglect from the caregiver or parent would mean that children can play around unsupervised, thereby increasing the likelihood of ocular injuries.

2. Accidents: Falls, collisions, or being struck by objects, are common causes of pediatric ocular injury. Children are naturally curious and may engage in activities that increase their risk of accidents, especially in environments like playgrounds or during unsupervised play. In Enugu - South East, Nigeria, the home was identified as the most common location of injury in pediatric patients (Okpala *et al*., 2015). Ranking high on the list, school and then the playground are the common places that ocular injuries occur besides the home (Aghadoost *et al.,* 2012; Pardhi *et al.,* 2015; Ugalahi *et al.,* 2023; Patel *et al.*, 2022).Beyond general accidents, specific household incidents can also lead to ocular injuries in children. For example, mishaps with sharp objects like scissors or knives, playing with toys with sharp edges, or accidents involving common household items like pens or pencils can result in eye injuries. Some toys, especially those with projectiles or sharp edges, pose a risk of ocular injury if not used properly. These include toy guns, slingshots, or toys with sharp projectiles can accidentally hit a child's eyes, causing injury. Interactions with household pets or encounters with stray animals can lead to ocular injuries in children, particularly from bites or scratches to the eye area.

3. Sport injuries: Participation in sports exposes children to the risk of ocular trauma, particularly in high-impact sports like baseball, basketball, or soccer. Blows to the eye from equipment, such as balls or rackets, or collisions with other players can cause significant injury to the eye. 65% of blunt trauma reported in Scotland were as a result of sport and recreational activities among children (Brophy *et al.,* 2006). Up to 90% of these sports related eye injuries are preventable by using adequate eye protection equipment (Ohana *et al.,* 2021). Protective eyewear made of polycarbonate, a highly impact-resistant plastic which is now easily available as prescription and non-prescription eyewear is available and all players should be encouraged to use them (Mishra *et al.,* 2012)

4. Chemical exposure: Exposure to harmful substances, such as household cleaners such as bleach, industrial chemicals, or even common items like soap or shampoo, can cause chemical burns or irritation to a child's eyes. Accidental ingestion or contact with these substances can lead to serious ocular injury if not promptly treated.

5. Foreign Bodies: Children may inadvertently get foreign bodies, such as sand, dirt, or small toys, lodged in their eyes while playing or exploring. These foreign bodies can cause scratches, abrasions, or corneal injuries if not removed carefully. Prompt medical attention is essential to prevent complications and ensure proper healing.

6. Use of forceps during delivery: Children may obtain injuries just at the time of birth. This may be due to the fact that a vaginal birth may not go as planned and the Gynecologist is forced to make split decisions. Obstetrical forceps which are used to hold on to the head of the baby and help guide the child out of the birth canal, may cause injury to the ocular adnexa and surrounding structures. A condition known as obstetrical forceps-induced Descemet membrane tear (FIDMT) is one of such complications encountered during forcep-asssisted delivery. This can in lead to astigmatism, amblyopia and ultimately, dilapidating disability (Agarwal *et al.,*2021).

Other causes of pediatric ocular injuries include; bungee cords, wire coat hangers, rubber bands, car crashes, fire arm accidents, fireworks or explosive device.

2.3 Characteristics of Pediatric ocular injuries

Ocular injures are as old as man. Ocular traumas are one of the major causes of unilateral blindness in man (Hashemi *et al.,* 2022). The occurrence of bilateral ocular injuries were found to be just 3% (Jamil *et al*., 2011) and 7% (Puodziuvene *et al.,* 2018).The distribution of ocular injury is bimodal with increased incidence seen in young adults and then the elderly (Qayum *et al*., 2016). About 54.9% of patients were seen to be under the age of 25 years old (Qayum *et al*., 2016). Children have a high incidence of ocular trauma due to their activities of play, curiosity, lack of experience and self-protection, and awareness (Xue *et al*., 2018). Pediatric ocular trauma do not just affect only the child's visual functional development but also physical and mental health thus creating a heavy burden on families and societies (Xue *et al.,* 2018).

In a bid to understand the age specific patterns of pediatric ocular injury, Pardhi *et al,* discovered that more prevalence was found in the age group of 5 years and above rather than below. School aged children were also found to be more susceptible. It was hypothesized that this was due to the nature of children at that age; independent and adventurous. In contrast, younger aged group children are under parental supervision and physically less active than their counterpart (Pardhi *et al.*, 2015).

In considering the pattern of pediatric ocular injuries, more than half of the injuries observed in the eastern city of the Emirates of Abu Dhabi happened in the left eye (56.4%) while the rest were in the right eye (43.6%) (Mahmoud *et al.*, 2020). This was in contrast with the study by Puodziuviene *et al* where no significant difference (right eye 49.3% vs left eye 50.7%) was observed between the right eye and left eye (Puodziuviene *et al*., 2018).

Traumatic brain injury is found to occur concomitantly occur with ocular injury with most pediatric patients presents with contusions of the eye and adnexa (39.1%) and orbital fractures (35.8%) (Gise *et al.*, 2018). The major type of injury necessitating hospitalization was hyphemia due to blunt trauma, accounting for 38% of cases. (Aghadoost *et al*., 2012; Brophy *et al.,* 2006) 67% of the children presented to the ER within the first 24 hours of sustaining the injury and 94% presented within the first 48 hours (Aghadoost *et al.*,2012). In a study by Saxena *et al* (2002) in India, 24% of the patients had presented 6hours after the injury and then 34% after more than 24hours after the injury. Early treatment was a key factor in good visual ocutome (Pardhi *et al.*, 2015). Those who visited late were due to poor parenthood, carelessness, poverty, extremely remote area and fear factor in children (Pardhi *et al.,* 2015). The average time of hospitalization was 3 days (Mahmoud *et al.,* 2020). Despite proper efforts and management, most children in Saudi Arabia suffered significant visual loss secondary to ocular trauma (AlGhadeer *et al.,* 2022).

In the rural community of Bangladesh, the vast majority of ocular injuries seen were open globe injuries (91%) while the rest were closed globe injuries (9%). The major type of injury was penetrating (81.4%) followed by lime burn (7%), ruptured globe (6.1%) and the others were 5% (Islam *et al.,* 2017). In the pediatric population in Owo Nigeria, blunt eye injury (84.1%) was seen to be the most common type of ocular injuries (Omolase *et al.*, 2011).

The type of injury sustained may also depend on one's geographical location. Open globe injuries were observed to be as high as 91% in hospital patients i.e those living in more developed region while only 18% for community patients. Conversely closed globe injuries were only 82% in community patients as opposed to 9% in hospital patients (Islam *et al.,* 2020).

For children, the major cause of the injuries were stone (48.3%) and pellets(30%) besides rubber bullets, sling shots and tear gas (Khan *et al.,* 2012). In the pediatric population in Ibadan; Wood/stick, cane, stone, broomstick and fist/palm/finger were the agents responsible for two thirds of the injuries (Ugalahi *et al*., 2023). A high rate of pediatric trauma as a result of dog bites were found in a trauma I center in Virigina (Reuter *et al.,* 2021). Sometimes, ocular injuries may be self-inflicted (Gise *et al..,* 2018). About 76.3% of pediatric ocular trauma due to unintentional injuries were associated with falls, assault or firearms (Gise *et al.,* 2018).

The pattern of ocular injuries in a region depends on the activities of the people living in that region. New Delhi saw a significant drop in the rare of fire cracker related injuries after a ban on the use of firecrackers was issued (Pujari *et al*., 2018). Similarly, recreational activities such as fishing, sports such as Crickets have also contributed to childhood injuries in regions were these activities are common (Madan *et al.,* 2020; Alfan *et al.*, 2005).

The prognosis of and injury depends on the structures that were effected. The most common structures affected by ocular injury are, the cornea (91%), conjunctiva (59%), iris and pupil(48%). 90% of these eye injuries can be prevented with proper education, supervision and proper safety eye protectors (Aghadoost *et al.*, 2012).

2.4 Pediatric Ocular Trauma Score (POTS)

The Ocular Trauma Score (OTS) was proposed by Kuhn et al in the early 2000s to provide a simple system with few variable to predict final visual outcome of an injured eye. Approximately 2,500 patients were evaluated and over 100 variables were selected from to build the OTS (Kuhn *et al.,* 2004). The variables used in the OTS are the initial visual acuity and then presence (or absence) of the following: globe rupture, endophthalmitis, perforating injury, retinal detachment (RD) and afferent pupillary defect (APD). To calculate the raw score, the variables A+ B+C+D+ E+F are summed up and then converted into the OTS to predict likelihood of final vision into categories. A score ranging from 1-5 is assigned with 1 being the most severe case with the poorest prognosis and with 5 being the least severe and having the best prognosis. There was an 80% accuracy of this system which means that there was a one in five chances that the prognosis was wrong (Kuhn *et al.,* 2004).

However a slight problem existed with this simplified system of predicting the prognosis in a pediatric population as in certain cases, it may be difficult to determine the initial acuity of children of certain ages. Furthermore, due to the nature of the injury, Relative Afferent Pupillary Defect may be difficult to determine. Acar *et al.,*(2011) proposed a new ocular system called the pediatric ocular trauma score. It was particularly used for children who had penetrating ocular injuries. The pattern follows that of the Ocular Trauma Score with minimal deviations. A raw score is given to each variable which includes the initial visual acuity, the location/zone of the injury and other factors such as iris prolapse, retinal detachment, and hyphemia. Conversion of the raw score into the sub score gives the pediatric ocular trauma score. Much like the OTS, there are five scores with one as the most severe with the poorest prognosis and five being the least severe case with a great prognosis. The POTS was found to be superior to the OTS in predicting the final visual outcome for patients in a pediatric population (Awidi *et al.,*2019).

- A POTS raw score of 0-45 is equivalent to 1
- A POTS raw score of 46-64 points is equivalent to 2
- A POTS raw score of 65-79 points is equivalent to 3
- A POTS raw score of 80-89 points is equivalent to 4
- A POTS raw score of 90-100 points is equivalent to 5

LP/HM	20
Counting fingers	30
0.1–0.5	40
0.6–1.0	50
Age of the pediatric patients (years)	
0–5	10
6–10	15
11–15	25
Wound location	
Zone I	25
Zone II	15
Zone III	10
Concomitant eye pathologies	
Iris prolapse	−5
Hyphema	−5
Organic/unclean injury	−5
Delay of surgery (>48 h)	−5
Traumatic cataract	−10
Vitreous haemorrhage	−20
Retinal detachment	−20

Pediatric Ocular Trauma Score (Acar *et al.,* 2011).

An equation is used to calculate the trauma score in patients in whom an initial VA was not obtained = 2×(age+zone)−corresponding pathologies.

2.5 Severity of ocular injuries

In the 2000s, there were 8.9 hospitalizations for eye injuries per 100,000 people ≤ 20 years in the United States (Brophy *et al.,* 2006). According to several studies, the prevalence of serious visual impairment or blindness in children due to ocular trauma varies between 2 and 14% globally with Open globe injuries accounting for 25% of those incidents (Lee *et al.,* 2008, Al-Mahdi *et al.,*2011). Most ocular injuries are typically not fatal but can sometimes require serious medical emergency attention that may result in permanent ocular damage and visual disability (Boret *et al.,* 2020). Developing countries with limited access to primary health care have higher prevalence of ocular trauma than developed centers (Alabdulkader *et al.,*2024)

The severity of the patients that present to J.A hospital, Gwalior was calculated using the trauma index and most of the injuries were classified as mild (Shukla *et al.,* 2018). The trauma index is calculated based on the structural loss, functional loss (visual acuity) and the time it took for the patient to recover (Shukla *et al.,* 2018).

The severity of ocular injuries encompasses a wide range of conditions ranging from simple sub conjunctival hemorrhage, lid laceration to even lens subluxation or dislocation, vitreous hemorrhage, retinal detachment, traumatic optic neuropathy, orbital fracture and lobe rupture. Minute variations occur in pediatric ocular injuries where there are instances of corneal laceration(53.8%), traumatic cataract(15.3%), foreign body (15.3%), hyphemia (12.8%) are the more common presenting symptoms (Mahmoud *et al.,* 2020).

CHAPTER THREE

3.0 METHODOLOGY

3.1 RESEARCH DESIGN

This research work followed a retrospective cross sectional study design that involved the collection of data of pediatric patients that presented with ocular injuries in Central hospital, Sapele, Delta State.

3.2 RESEARCH LOCATION

This research project was conducted using the Central hospital located in Sapele, Local government area, Delta State to obtain data of pediatric patients. The Sapele Central hospital is a public hospital located at Sapele local government area, Delta State. It is situated opposite the Magistrate court, Market road, Sapele, Delta state, Nigeria. It was established on the 1st of January, 1928 and operates on a 24 hour basis. The Sapele town is a port city in the Nigeria Delta region of Southern Nigeria, located on the Ethiope River. It is the headquarter of the Okpe Kingdom and is considered the center of the Nigeria timber industry. It boasts of its own Sawmill, a plywood, Veneer factory and other industries (Brittanica n.d.).

The Sapele hospital is a licensed hospital by the Nigeria Ministry of Health, with facility code 10/17/1/2/1/0003 and registered as a secondary healthcare center. It offers a wide variety of services ranging from Cardiology, Nephrology, Family Medicine, Optometry and Ophthalmology services. It is also fitted with an onsite Pharmacy, Laboratory, Ambulance and Mortuary services (the hospital book n.d.).

It caters to the population of 174,273 people with many Nigerian ethnic groups of Okpe, Itsekiri, Ijaw and Urhobo. There is no hospital commensurate to its size and significance in the entire community and the wide variety of services it renders serves as a major draw for patients in the entire town.

3.3 STUDY POPULATION

The study consisted of all the clinical records of cases of patients with ocular injuries from January 2020-October 2024. This study focused on pediatric population of both gender that presented to the Optometric and Ophthalmology section.

3.4 RESEARCH MATERIALS

- Case files of patients from January 2020-October 2024.
- Microsoft Excel 2016 was used to collect the records in an orderly manner.

3.5 INCLUSION/EXCLUSION CRITERIA

3.5.1 INCLUSION CRITERIA

I. Recorded cases ocular injuries seen during the time frame(January 2020- October 2024)

II. Patients within the ages of 1day- 18 years

III. Pediatric patients who have sustained ocular injuries

IV. Pediatric ocular injury cases that present to Central Hospital, Sapele.

3.5.2 EXCLUSION CRITERIA

Participants were excluded from the study based on the following criteria.

I. Cases of ocular injuries that were not seen within the specified time frame

II. Patients who were above the age of 18 years even when they presented with ocular injuries.

III. Pediatric patients with pathological conditions

3.6 ETHICAL CONSIDERATION

Ethical approval to conduct this study was attained from the ethics committee of Optometry Department, University of Benin. Informed consent was sought from the hospital's management, which included a clear explanation of the study's purpose, procedures, and the measures taken to protect patient confidentiality.

To safeguard patient confidentiality, all data extracted from medical records were made anonymous by excluding all unique identifiers such as the patients name and address. .

3.7 DESCRIPTION OF PROCEDURE

This study was carried out in the Central hospital, Sapele, Delta State. After the relevant consent and approval have been obtained, all available cases files containing record of Pediatric patients with ocular injuries seen during January 1st 2020- October 31st 2024 were pulled for the research. Data was meticulously extracted in order to meet the purpose and objectives of the study and was entered in an already prepared spreadsheet. Unique identifying information such as the patient's name and address was omitted, complying with the standards set by the Ethics Committee of the University of Benin.

The following data was then drawn out from the sampled case files:

1. Age of the patient
2. Gender of the patient
3. The laterality/eye affected
4. Date of case presentation to the eye clinic
5. Cause of injury
6. Onset of the injury

7. First aid treatment/ initial treatment taken before the patient came to the hospital
8. Initial Visual acuity of the patient
9. Ocular tissue affected
10. Diagnosis
11. Classification of the Ocular injury using the BETTS as a reference point
12. Type of treatment administered
13. Drugs administered
14. Final visual acuity
15. Time taken to recover

3.8 DATA ANALYSIS

The gathered data was entered into a Microsoft Excel 2016 spreadsheet, and statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS), Version 25.0. Descriptive statistics, including frequency, mean, standard deviation, and percentages, were calculated to assess the distribution of refractive errors among undergraduate students. Chi-square tests were used to explore associations between categorical variables such as gender and type of injury. Statistical significance was set at $p < 0.05$, with findings presented in tables, pie charts and stacked bar chart in order to facilitate interpretation and inform strategies for pediatric eye care at the community level.

3.9 LIMITATIONS OF STUDY

1. This study was limited by its methodology, variations in the thoroughness of data entered in medical records as well as use of ambiguous language. Circumstances' surrounding some instances of ocular trauma were not available and it was impossible to get clarification.

2. The results may be skewed towards mild and moderate injuries as majority of the patients whose conditions were serious enough to require specialist care were lost to follow-up.
3. The focus of this study on pediatric patients, reduces its applicability to other demographics such as adults.

CHAPTER FOUR

4.0 RESULTS

Case reports of 223 patients were pulled from the file records of pediatric patients who reported to the hospital with a history of ocular injury and these were analyzed. The patients with pediatric ocular injury consisted of 139(62.3%) males and 84(37.7%) females. The mean age of these patients were 11.46 ± 4.95 with the minimum and maximum age being 3 months and 18 years respectively. The mean age of the males were 11.84 ± 4.7 and the mean age of the females were 11.04 ± 5.2. The patients were grouped into the age groups: (0-4), (5-9), (10-14), (15-18). The patients were aged 0-4(25.6%), 5-9(29.6%), 10-14(33.6%), 15-18(11.2%). More than half of the patients sustained injuries in the left eye (53.4%). Injuries were also sustained in the right eye (37.7%) and both eyes (9.0%). The type of injury sustained was classified according to BETTS and given as closed globe injury (76.1%), open globe injury (6.7%), non-globe injury (4.1%), chemical injury (4.5%), thermal injury (1.8%) and mixed injury (5.4%). Most of the patients did not use any drug or form of first aid treatment (58.7%) before coming to the clinic. More than half of the patients presented to the clinic a day- one week (53.4%) after their symptoms started. This is shown in table 4.1

TABLE 4.1: Characteristics of Pediatric patients with ocular injuries

Gender of pediatric patients

Gender	Frequency	Percent(%)
Male	139	62.3
Female	84	37.7
Total	223	100

Age characteristics of patients

Age	Frequency	Percent(%)
0-4	57	25.6
5-9	66	29.6
10-14	75	33.6
15-18	25	11.2
Total	223	100

Laterality of pediatric patients

Laterality	Frequency	Percent(%)
OD(Right eye)	84	37.7
OS(Left eye)	119	53.4
OU(Both eyes)	20	9.0
Total	223	100

Type of injury according to BETTS

Type of injury	Frequency	Percent(%)
Closed Globe injury	171	76.7
Open globe injury	15	6.7
Chemical injury	10	4.5
Thermal injury	4	1.8
Non-globe injury	11	5.4
Mixed injury	12	4.9
Total	223	100

Time of patient's first hospital visit after symptoms began

Time taken	Frequency	Percent(%)
Same day	6	2.7
One day-One week	115	53.4
Two weeks	10	4.5
Three weeks	3	1.3
One month	11	4.9
Six weeks	1	0.4
Two months	5	2.2
Three months	3	1.3
Four months	1	0.4
Six months	2	0.9
Seven months	1	0.4
Nine months	1	0.4
One year	3	1.3
Two year	2	0.9
Unreliable memory	55	25.0

Total	223	100

First aid/initial treatment used by the patient before first hospital visit.

First aid	Frequency	Percent(%)
Nothing used	131	58.7
Unknown GUTT	26	11.7
Gentamicin	12	5.4
Chloramphenicol	12	5.4
Breastmilk	6	2.7
TEM	12	5.4
Others	26	11.5
Total	226	100

Key: GUTT= Eyedrop , TEM= Traditional Eye Medicine

The result from this study showed the distribution of age group on gender with 5-9 years having the highest incidence of pediatric ocular injuries, with the male gender being more prominent in this group (31.1%). For the laterality/eyes affected, the male gender suffered more assault to the left eye (53.96%). When considering the type of injury, the closed globe injury was overwhelming dominant in the data set with the male (76.68%) gender being more predominant within in the data set.

A chi-square analysis was done to determine if there was a statistically significant relationship across the sets of data. There was no statistically significant relationship between the age group and the gender of the patient (p value=0.660). There was no statistically significant relationship between the eye affected and the sex of the patient (p value=0.668). There was no statistically significant relationship between the type of injury and the sex of the patient (p value=0.309). Significance levels (alpha=0.05). This is shown in table 4.2

Table 4.2: Sex based distribution by age group, laterality and type of injury.

Variables	Gender, n (%)		Total(n=223)	Statistical indices
	Male, 139(62.33%)	Female, 84(37.67%)		
AGE GROUP				df=3 x2=1.596 p=0.660
0-4	36(25.9)	21(29.6)	57(25.6)	
5-9	46(33.1)	21(25.0)	67(30.0)	
10-14	43(30.9)	31(36.9)	74(33.2)	
15-18	15(10.8)	10(11.9)	25(11.21)	
LATERALITY				df=2 x2=0.807 p=0.668
LEFT EYE	75(53.96)	44(52.38)	119(53.36)	
RIGHT EYE	50(35.97)	34(40.48)	84(31.67)	
BOTH EYES	14(10.07)	6(7.14)	20(8.97)	
TYPES OF INJURY				df=5 x2=5.968 p=0.309
CLOSED GLOBE INJURY	103(74.10)	68(80.95)	171(76.68)	
OPEN GLOBE INJURY	12(8.63)	3(3.57)	15(6.73)	
NON GLOBE INJURY	8(5.8)	3(3.57)	11(4.93)	
MIXED INJURY	7(5.04)	5(5.95)	12(5.38)	

THERMAL INJURY	4(2.88)	0(0)	4(1.79)	
CHEMICAL INJURY	5(3.60)	5(5.95)	10(4.48)	

The initial visual acuity for pediatric patients during their first visit to the Optometry section in Central hospital were taken and grouped according to WHO classification of visual acuity (World Health Organization, 2013). For younger children who could not read nor write letters, VEP was recorded. This was shown in table 4.3

TABLE 4.3: Initial visual acuity of the pediatric patients during their first visit to the hospital.

Initial Visual Acuity	Frequency	Graduating students	Percent(%)
VEP	14		6.8
6/6	66		29.6
6/9-6/18	51		22.9
6/24-6/48	8		3.6
6/60-3/60	13		5.8
<3/60-NLP	49		22.0
NON COMPLIANT	22		9.8
Total	223		100

Key: VEP=Visually Evoked Potential, NLP=No Light Perception.

The distribution of initial visual acuity of the pediatric patients that presented to Sapele was determined based on the cause. Ocular injuries caused by physical assault (40.6%) were found to have an initial visual acuity of 6/6. Half of the patients that were hit by broomstick (50%) presented to the hospital with an initial visual acuity of 6/9-6/18. More than half of the patients who were hit by rubber band (60%) had an initial visual acuity of <3/60-NLP. While more than half of the ocular injuries that were caused by falls (60%) had an initial visual acuity recorded of VEP.

A chi square test was done to determine if there was a statistically significant relationship between the initial visual acuity and the cause of injury and a statistically significant relationship was found between the initial visual acuity and the cause of injury ($p<0.05$). This is shown in table 4.4.

TABLE 4.4: Distribution of initial visual acuity of pediatric ocular injury by the cause

Cause	Initial visual acuity n(%)							
	6/6	6/9-6/18	6/24-6/48	3/60	<3/60-NLP	VEP	Non-compliant	Total
Physical assault	13(40.6)	7(21.9)	2(6.3)	1(3.1)	5(15.6)	1(3.1)	3(9.4)	32(100.0)
Stone	5(29.4)	1(5.9)	0(0.0)	2(11.8)	4(23.5)	1(5.9)	0(0.0)	13(100.0)
Broomstick	2(14.3)	7(50.0)	0(0.0)	1(7.1)	3(21.4)	1(7.1)	0(0.0)	14(100.0)
Falls	2(20.0)	1(10.0)	0(0.0)	1(10.0)	0(0.0)	6(60.0)	1(10.0)	11(100.0)
Others	15(25.0)	14(23.3)	2(3.3)	2(3.3)	18(30.0)	1(1.67)	8(13.3)	60(100.0)
Pencil/pen	2(22.2)	2(22.2)	0(0.0)	3(33.3)	0(0.0)	2(22.2)	0(0.0)	7(100.0)
Rubber band	1(20.0)	1(20.0)	0(0.0)	0(0.0)	3(60.0)	0(0.0)	0(0.0)	5(100.0)
Self-inflicted	5(41.7)	4(33.3)	0(0.0)	0(0.0)	3(25.0)	0(0.0)	0(0.0)	12(100.0)
Foreign body	4(33.3)	3(25.0)	1(8.3)	1(8.3)	2(16.7)	0(0.0)	1(8.3)	12(100.0)
No known	15(34.1)	7(15.9)	2(4.5)	1(2.3)	9(20.5)	2(20.45)	8(18.2)	44(100.0)
Cane	2(18.2)	4(36.3)	1(9.1)	1(9.1)	2(18.2)	0(0.0)	1(9.1)	11(100.0)

Key: VEP=Visually Evoked Potential, NLP= No Light Perception

The final visual acuity for pediatric patients after treatment was taken and grouped according to WHO's classification of visual acuity (World Health Organization, 2013). Majority of the patients presented with a visual acuity of 6/6(74.6%). For younger children who could not read nor write letters a record of VEP was recorded for them. A number of cases were lost to follow up (19.2%) and final visual acuity could not be taken. This was shown in table 4.5

TABLE 4.5: Final visual acuity after treatment

Final Visual Acuity	Frequency	Graduating students	Percent(%)
VEP	18		8.1
6/6	100		44.8
6/9-6/18	35		15.7
6/24-6/48	1		0.4
6/60-3/60	3		1.3
<3/60-NLP	23		10.3
LOST TO FOLLOW-UP	43		19.3
Total	223		100

Key: VEP=Visually Evoked Potential, NLP=No Light Perception

The severity of injuries for pediatric patients that presented to Central Hospital, Sapele was calculated and grouped in mild and moderate injuries. There were no incidence of high severity. In certain cases, severity could not be determined as some cases which were referred to a specialist were lost to follow up. More than half of the injuries (56.95%) were mild. This is shown in table 4.6

TABLE 4.6- Severity of pediatric ocular injury

Severity	Frequency	Graduating students	Percent(%)
Mild	127		57.0
Moderate	50		22.4
Lost to follow-up	46		20.6
Total	223		100

The result from this study showed the distribution of severity of ocular injury on age group with 10-14 having the highest incidence (n=63) of pediatric ocular injuries. There was also higher occurrence of mild injuries (69.9%) within this age group. There was a higher occurrence of moderate injuries (30.4%) within the age group of 5-9 years. In considering the type of injury, majority of the closed globe injuries were mild 107(74.3%). Most of the mild injuries were seen in patients who came in with an initial VA of 6/6 while majority of the moderate injuries were mostly seen in patients who presented to the clinic with a VA 34(68%) of <3/60-NPL.

Chi square test was done to determine if there was a statistically significant relationship across the sets of data. There was a statistically significant relationship between the initial VA and the Severity of the injury (p value=0.000). There was no statistically significant relationship between the age group and the severity of the injury (p value=0.850). There was no statistically significant relationship between the gender and the severity of the injury (p value=0.285). This is shown in table 4.7

TABLE 4.7: Distribution of initial visual acuity, type of injury according to BETTS, age group by severity

Variables	Severity			
	Mild n(%)	Moderate n(%)	Total(N=177)	Statistical indices
Age group				X^2=0.852
0-4	26(0.2)	8(23.5)	34	df=3
5-9	39(69.9)	17(30.4)	56	p=0.837
10-14	46(73.0)	17(27.0)	63	
15-18	16(66.7)	8(33.3)	24	
Type of injury				
Closed globe injury	107(74.3)	37(25.7)	144	
Open globe injury	1(33.3)	2(66.7)	3	x^2 =10.316
Thermal injury	6(75.0)	2(25.0)	8	df=5
Chemical injury	7(87.5)	1(25.0)	8	p value =0.067
Non-globe injury	5(50.0)	5(50.0)	10	
Mixed injury	1(25.0)	3(75.0)	4	
Initial Visual Acuity				
VEP	12(100.0)	0(0.0)	12	x^2=118.035
6/6	60(98.4)	1(1.6)	61	df=6
6/9-6/18	44(91.7)	4(8.3)	48	p value=0.0000
6/24-6/48	3(50.0)	3(50.0)	6	
6/60-6/36	2(22.2)	7(77.8)	9	
<3/60-NLP	4((10.5)	34(89.5)	38	
NC	2(66.7)	1(33.3)	3	
Total	127	50		

Key: p value <0.05- Significant, p value>0.05- Not significant, df=degree of freedom, x^2=chi square value, NC=Non-compliant, VEP= Visually Evoked Potential

The management protocol for pediatric ocular injuries that presented to the Optometry section of Central Hospital, Sapele was determined and grouped into medical, surgical, non-medical and referral. Most of the injuries diagnosed required medical treatment. Other times, a combination of some or all of the management protocols were used. About 99% of patients who were referred for specialist consultation were lost to follow-up. This was represented in Table 4.8

TABLE 4.8: Management of pediatric ocular injuries

Management	Frequency	Graduating students	Percent(%)
Medical	196		87.9
Surgical	5		2.2
Counselling	6		2.7
Referred	8		3.6
Combination	8		3.6
Total	223		100

The average time it took for a pediatric patient to recover and/or be discharged from the clinic after diagnosis was made. This is shown in table 4.9.

TABLE 4.9. Average time taken for patient to recover

Diagnosis	Average time	Admitted

Corneal ulcer	2 weeks	No
Sub conjunctival hemorrhage	1 week	No
Superficial lid laceration	1 week	No
Corneal abrasion	1 week	No
Orbital cellulitis	3 weeks	5 days
Pre orbital cellulitis	1 week	3 days
Traumatic uveitis	4 weeks	No
Ocular trauma	1 week	No
Corneal laceration	1 week	No
Traumatic keratitis	3 weeks	No
Corneal foreign body	1 week	No
Blind eye	5 weeks	No
Traumatic conjunctivitis	1 week	No
Deviation	Same day	No
Traumatic optic atrophy	2 months	No
Traumatic cataract	1 month	No
Abradded sclera	2 weeks	No
Closed globe injury	2 weeks	No
Conjunctiva swelling	1 week	No
Ectopic lentis	3 weeks	No
Corneal scar	4 weeks	No
Retrobulbar hemmorhage	1 month	No
Ocular burn	2 weeks	No
Vitreous hemmorhage	1 month	No
Hyperemia	1 week	No

The cause of injuries of pediatric patients in Central Hospital, Sapele were, physical Assault (14.4%) and Broomstick (6.3%). Some injuries were self-inflicted (5.3%). About 20% of the patients could not pin point the exact cause of the injury. This is shown in figure 4.1

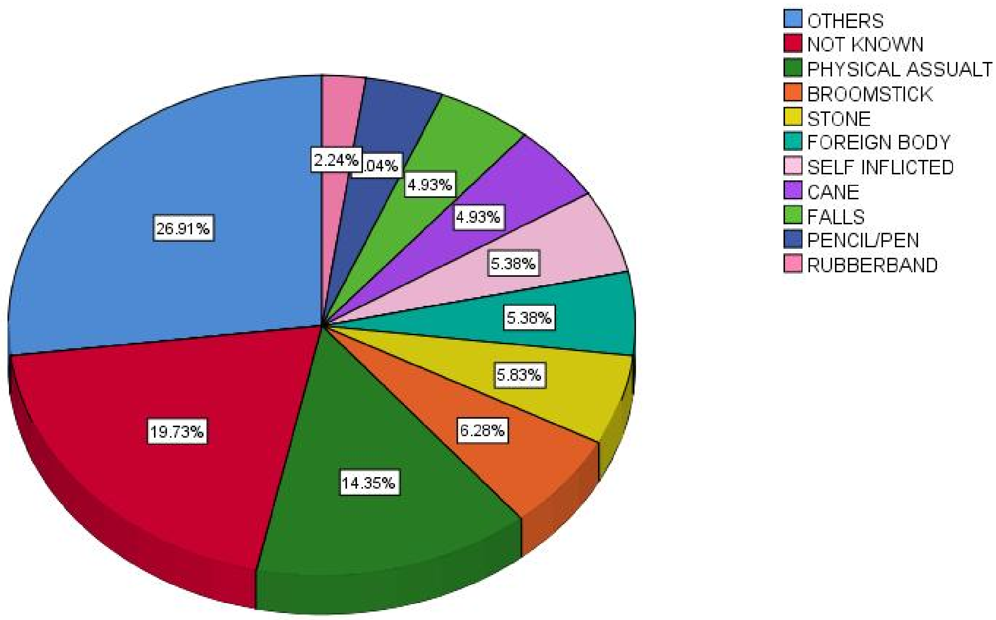


Figure 4.1. Cause of pediatric ocular injury

The tissues that were affected in Pediatric Ocular injures that presented to Central Hospital indicated that the Cornea (57.4%), the Conjunctiva (17.9%) and the Eyelid (9.4%) were the most affected ocular tissue. This is shown in figure 2

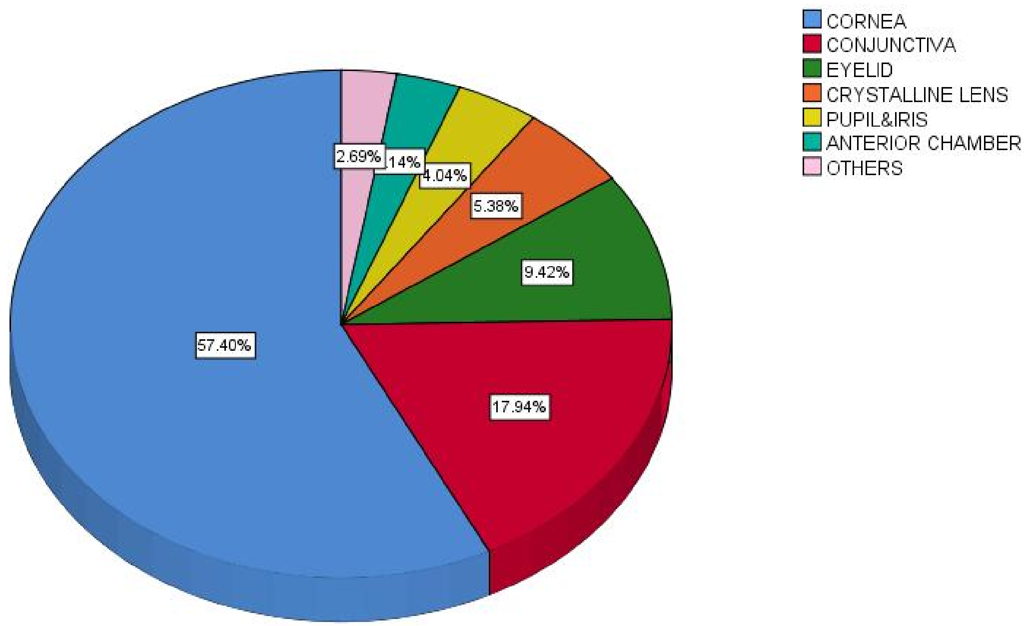


Figure 4.2. Ocular structures affected by pediatric ocular injury

In this study, the distribution of initial visual acuity based on the type of injury showed that closed globe injury (n=54) had the highest frequency with preponderance of initial visual acuity of 6/6. Thermal injuries (n=4) had the lowest incidence with initial VA preponderance of 6/9-6/18. The chi-square analysis was used to determine if there was a significant relationship between the two variables. There was no significant relationship between the type of injury and the initial visual acuity.(p=0.063). Significance level is taken as 0.05. This is shown in figure 3.

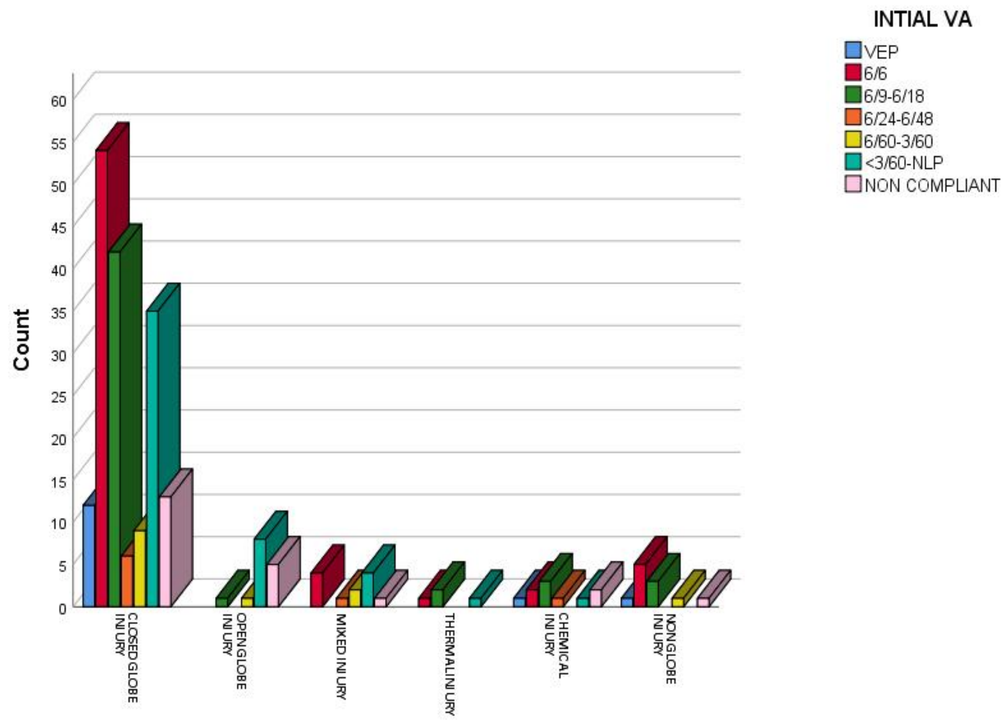


Figure 4.3. Distribution of the type of injury by initial visual acuity

The distribution of the severity of ocular injuries by gender was determined. Majority of the mild injuries (n=78) occurred in the Male gender. A chi square analysis was used to determine if there was a statistically significant relationship between gender and severity. There was no significant relationship between gender and age group (p value=0.285). This is shown in figure 4.

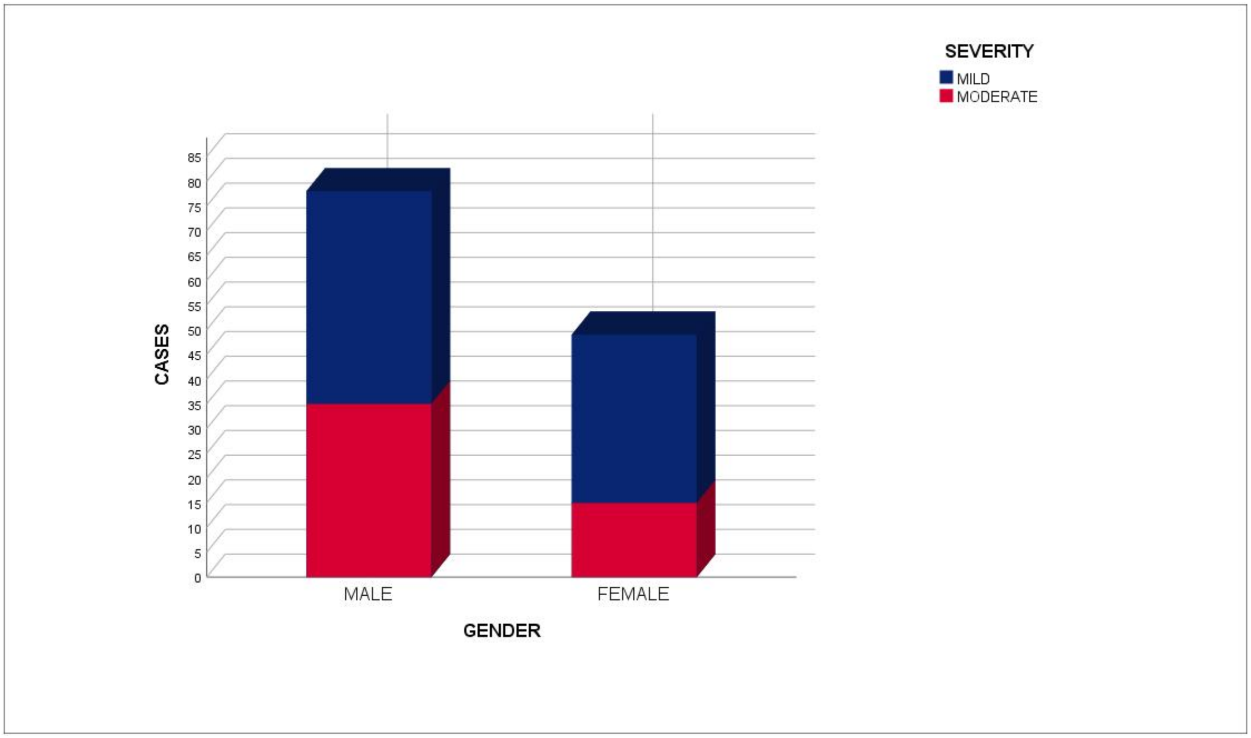


FIGURE 4.4 Distribution of the severity of ocular injury by gender.

In this study, the most common diagnosis made for pediatric ocular injury was Corneal ulcer (n=77). A non-specific diagnosis of ocular trauma was given to most non penetrating injuries that presented to the clinic. Other diagnosis include iris prolapse, vitreous hemorrhage and optic atrophy. This is shown in figure 5.

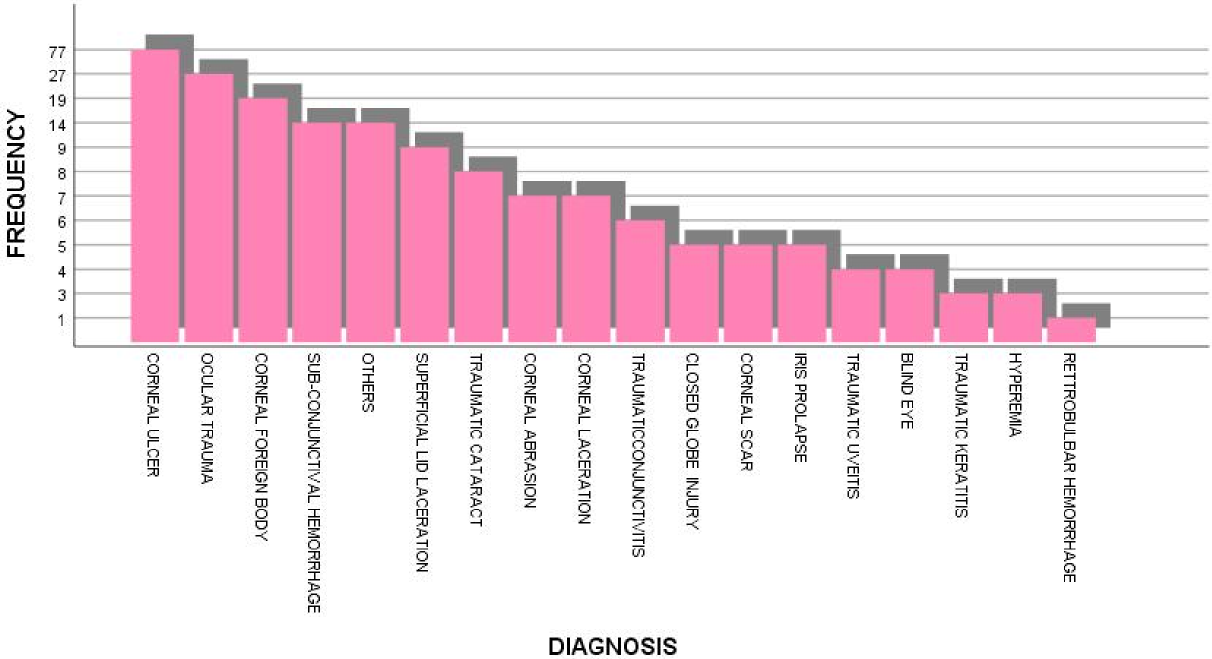


FIGURE 4.5. Diagnosis of pediatric ocular injury.

CHAPTER FIVE

5.0 DISCUSSION

Pediatric ocular injures are a significant public health concern due to their potential to cause long term visual impairment and disability. Several studies (Abraham *et al.,*2021, Farooq *et al.,* 2024) have been done to show the pattern and characteristics of pediatric ocular injuries in patients that present to the hospital.

This study observed a male preponderance with 62.3% (139) males than females with a ratio given as 1.67:1. This male preponderance is consistent with numerous studies (Okeigbemen *et al.,* 2013, Chien *et al.,* 2020, Abraham *et al.,* 2021, Patel *et al.,* 2022, Alabdulkader *et al.,* 2024). This is often attributed to the fact that males are often adventurous and somewhat aggressive in nature, (Shoja & Miratashi 2006, Okeigbemen *et al.,* 2013, Abraham *et al.,* 2021)

There was a higher percentage of ocular injuries in patients of the age group 10-14(32.6%). It is postulated that children of this age group are likely to be more independent and are more likely to be involved in unsupervised activities (MacEwen *et al.,* 2010, Abraham et al., 2021). Childhood ocular trauma is usually centered around 9 years with frequent cases in the 6-11 years (De'onte *et al*., 2021, Kacer *et al.,* 2022, Ugalahi *et al.,* 2023) and the 9-15 years group (Kaddapu *et al.,* 2013, Maurya et l., 2017, Kadappu *et al.,* 2017). Differing from our result, in the study conducted in Eygpt, where El-Sebalty*,* found that majority of pediatric trauma occurred in children from ages of 2-7 years of age (El-Sebaity *et al*., 2011). In Riyandh, Saudi Arabia, Alabdulkader*,* found the prevalence of ocular injuries among children (46%) of the age group 5-9 (Alabdulkader *et al.,* 2024).

In this study, there was minimal difference in the distribution of ocular injuries by gender (male, 25.9% vs female, 29.6%) in the age group of (0-4) years. The difference in distribution by gender widens to roughly twice the injuries occurring in males than females as they enter the age group 5-9 years (male, n=46 vs female n=22). The difference in gender related distribution finally narrows down in the age group 15-18 years with a small difference in distribution in the two genders (male, n=15 vs female, n=10) . The relationship between gender and distribution of injuries however, is not statistically significant ($p>0.05$). The relatively lower and almost equivalent rates of injuries in the younger age group could be as a result of the fact that when children are much smaller, both boys and girls engage in the similar activities under supervision of their guardians (Hosseni *et al.,* 2011, IIhan *et al.,* 2013, Abraham *et al.,*2021).

Majority of the injuries sustained were unilateral with the left eye affected the most (53.4%). This was corroborated by findings of Okeigbemen *et al.,* (2013), Okoye *et al.,* (2014), Faroq *et al.,* (2024.) This may be due to the fact that the left eye is more likely to be hit when slapped with the right hand or when hit with a cane/belt by a person who is right handed (Okeigbemen *et al.,* 2013). In other studies, there was no significant difference between the left eye and the right eye Puodiuviene *et al.,* 2018, Alabdulkader *et al.,* 2024).

This study showed that pediatric ocular trauma was caused by physical assault (14.4%), broomstick (6.3%) and projectile objects such as stone (5.8%). This was corroborated by a study done by El-Sebaity *et al.,* (2011). In Egypt, blunt injuries, sharp trauma and foreign body injuries with limited cases of fights were the cause of ocular trauma in children.

In this study, falls were the most common (81.81%) cause among children of the ages 0-4 years. This may be due to the fact that children of this age have limited mobility and are more likely to fall out of their crib or bed when not properly supervised by their guardian. Most of the patients within the age group 5-9 years sustained injuries from stone (49.2%), during play. Physical assault with fists and belts were mostly found in the age group of 10-14 (34. 4%).This injury was mostly inflicted by the parent or guardian. Other causes of injury involved sharp objects like Broken bottles, knives, scissors, pencil sharpeners, radio antennas, RTA and even a soccer ball. Chemical injuries were sustained from dettol and soap splash during bath time, superglue and insecticide. thermal injuries occurred as a result of Fireworks, pepper Spray, hot water, burning tire. Foreign body were gotten from sand, fingernails and iron particles. Family and community safety precautions to prevent injuries by household hazards and during recreational activities is recommended (Farooq *et al.,* 2024). There was a statistically significant relationship observed between the age group and the cause of injury (p= 0.023).

Closed globe injuries were the most (76.1%) common findings in this study. This is consistent with the study done by Abraham *et al.,*(2021) in Uyo where 80% of closed globe injuries were diagnosed and Faraq *et al.,*(2024) who found 74% of closed globe injuries in Brazil. This was also corroborated by another study by Puodziuviene *et al.,* (2018) and Alabdulkader *et al.,* (2024). Shoja and Miratashi however, reported a higher than average open globe injury (51.7% vs 33%). This was due to the fact that outpatient pediatric patients were excluded from this study (Shoja &Miratashi, 2006).

More than half of the patients in this study presented to the clinic after one day to a week after (53.4%) their symptoms had started. This is consistent with the study of Okeigbemen *et al.,* (2012) and was corroborated by another study where children presented to the clinic more than one day after trauma has occurred (Minderhound *et al.,* 2016). Early presentation to the hospital is very important for quick intervention and the possible salvaging of vision (Pardhi *et al.,* 2018). A good number of the patients could not pin-point the exact time their symptoms started (25%) due to poor memory. This is one of the draw-backs of diagnosing pediatric patients as they often make for unreliable historians (Akca *et al.,* 2022). Their guardians are not much help either as they are not directly affected, they may not be paying close attention to their wards until the symptoms become severe. The lack of urgency in reporting to the clinic could be due to the fact that majority of the cases seen in Central Hospital, Sapele were typically CGI. OGI such as penetrating injuries, were associated with more rapid care seeking compared to CGI (Li *et al.,* 2020).

The anterior part of the eye was most affected despite the anatomical and physiological protective mechanism (Abraham *et al.,* 2021). The ocular tissue affected the most was the cornea(57.40%), followed by the conjunctiva(17.94%) and then the eyelid(9.42%). Aghadoost *et al*., (2012) found that the most common structure affected during ocular injury was the cornea (91%), the conjunctiva(59%) and then the iris and pupil (48%). This was not the case as seen in the study in Uyo where the conjunctiva was most affected, followed by the cornea and the eyelids (Abraham *et al.,* 2021).

This research revealed that the most common diagnosis made for pediatric ocular injury was corneal ulcer (n=77). A nonspecific diagnosis of ocular trauma was given to most non penetrating injuries that presented to the clinic. In Saudi Arabia, the most common type of injury was cornea abrasion (30.5%), followed by contusion injuries (25.4%) with lamellar laceration being the least kind of injury (Alabdulkder *et al.,* 2024).

More than half of the patients that presented to the Central Hospital Sapele did so without the prior use (58.7%) of any drug or form of first aid treatment. This research revealed an inclination of the residents of Sapele to supplement traditional eye medicine with the use of common antibiotic eye drops. This includes, gentamicin, chloramphenicol eye drop and ointment. Among the analgesics used, most patients favored the use of paracetamol while a lesser percentage made use of diclofenac eye drops and Ibruprofen. The infants were often given a first aid treatment of milk from their mother's breast before presenting them to the hospital. Other medications include palliative treatment such as cold compresses, corneal irrigation, and Eye patch. Drugs such as Visine, Diclofenac, Ciprofloaxacin, Chymoral, T.mycin, Maxitrol, Betadone N, Dexamthasone, Ampiclox, Vitamin A and Vitamin C were also taken prior to first visit. These drugs were usually obtained from a local pharmacy while others were gotten from a nearby Optometry clinic before the patient was referred to Central Hospital.

This research showed that more than half of the injuries (56.95%) of pediatric patients that presented to the clinic were mild. Among the male population, there was a higher incidence of mild injuries 78(61.41%). Most of the mild injuries were seen in patients who came in with a VA of 6/6 while majority of the moderate injuries 34(68%) were mostly seen in patients who presented to the clinic with a VA of <3/60-NLP. There was a statistically significant relationship between the initial VA and the severity of the injury ($p<0.05$)

Closed globe injury (n=171) had the highest frequency with preponderance of initial visual acuity of 6/6(31.58%). Open globe injury (n=13) had an initial visual acuity preponderance of <3/60-NPL.There was no significant relationship between the type of injury and the initial visual acuity.($p>0.05$)

Majority of the injuries were managed with the use of medication. Patients that had been diagnosed with orbital and pre-orbital cellulitis were admitted into the hospital for treatment and observation. The average period for hospitalization was for 3 days. This was in line with study done by Mahmound *et al.,* (2020). Pediatric patients who had superficial lid laceration did not need any surgical intervention. Patients who had cataract surgery extraction were not admitted (discharged the same day). Most of the injuries diagnosed required medical treatment: Antibiotics, (intravenous, ointment and eye drops were given), Corticosteroids such as dexamethasone were also given. In some cases, a combination of some or all of the management protocols were used. Palliative treatment of cold and warm compresses were recommended, irrigation was done for patients that had foreign bodies stuck in their eye. Counselling was typically given to patients who suffered mild to moderate corneal scarring. All cases of iris prolapse were referred to specialist and teaching hospitals. About 99% of patients who were referred for a surgery or specialist consultation did not report to the clinic after the first visit.

49 eyes (22.0%) of the patients were found to have a visual acuity of <3/60-NPL at presentation, while 23(10.3%) were found to have severe visual impairment after treatment. This shows the high risk of visual loss associated with ocular trauma (Okeogbemen *et al.,* 2013).

CHAPTER SIX

6.0 CONCLUSION

From this study, it was concluded that pediatric ocular injuries are a significant health concern with a higher prevalence among males (62.3%). The most affected age group was 10-14 years (33.6%), likely due to the increased independence and engagement in unsupervised activities. Closed globe injuries were the most (76.1%) common types of injury, and the cornea was the most frequently affected ocular structure. The most common cause of injury were physical assault (14.4%), Broomsticks (6.3%) and some were self-inflicted (5.3%). Cornea ulcer (n=77) was the most common diagnosis for patients who visited the hospital and patients took a week on average to recover. A majority of patients that presented to the clinic did not use any first aid treatment (58.7%) before presenting to the clinic while some parents resorted to the application of traditional eye medication and many breastfeeding mothers used their breastmilk as first aid before presenting the baby to the hospital.

A statistically significant relationship was observed between the age group and the cause of injury (p=0.023). There was also a statistically significant relationship between the age group and the gender of the patient (p=0.660). The study found that more than half of the pediatric patients delayed seeking medical attention (53.4%) for one day to a week, resulting in severe visual impairment in 10.3%. Majority of the cases of pediatric ocular injuries were mild (57.0%) and handled with the use of medical (87.9%) treatment (drugs). The average period of hospitalization for pediatric patients was 3 days. About 99% of the patients that were referred for consultation with a specialist did not report to the clinic after the first visit.

6.1 RECOMMENDATION

From this study, the following recommendations are made

1. Parents and caregivers should be educated on the common causes of pediatric ocular injuries, underscoring the need for supervision particularly among younger children as they are more prone to falling. Proper surveillance should also be buttressed as this allow for early detection of ocular injury and ultimately, early intervention.
2. There should be awareness campaign to highlight the importance of hospital visits for occur trauma to prevent long term visual impairment.
3. Schools should implement safety programs and first aid training in order to manage ocular injuries. An ocular first aid box should be considered a necessity in most schools. This would contain a saline solution for irrigation, artificial tears for lubrication and eye relief, antibiotic medication and antihistamines. An eye shield to protect an injured eye from further damage, a magnifying glass for foreign body examination and tweezers to remove superficial foreign body. Analgesic medication may also be added in order to provide pain relief.
4. The use of protective eye wear should be encouraged for children engaging in high risk activity such as sports, manual labor. Household safety measure should be reinforced to reduce the risk of injuries caused by common house hold items.
5. Hospitals should implement better tracking and follow-up mechanisms for patients to reduce the high rate of lost-to-follow-up cases.
6. |I recommend that more research work should be done in order to explore the additional causes, severity and management of pediatric ocular injuries with a view to determining better visual outcomes for children.

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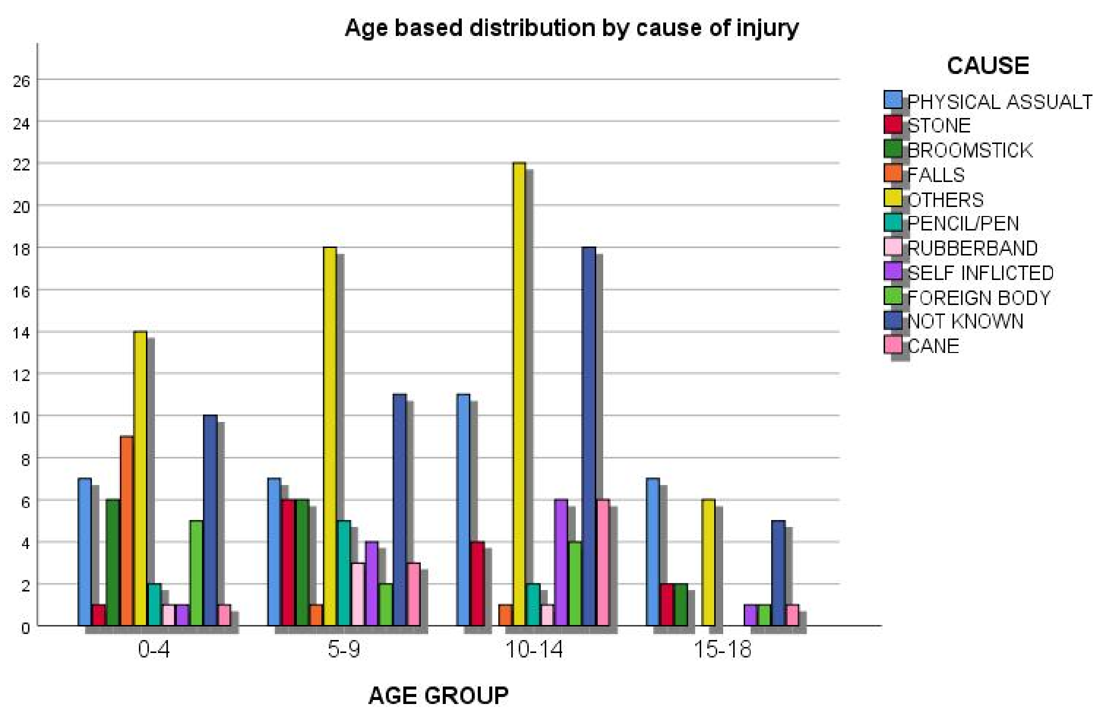
APPENDICES



Age group*cause of injury crosstab

	value	df	Asymptomatic significance (2-sided)
Pearson chi-square	47.365[a]	30	0.023
Likelikood ratio	50.393	30	0.011
Linear-by-linear association	0.151	1	0.697
N of valid cases	223		

a. 34 cells (77.3%) have expected count less than 5. The minimum expected count is 0.56

Gender

Gender	Frequency	Valid percent	Cumulative percent
Male	139	62.3	62.3
Female	84	37.7	100
Total	223		

Age group of patients

Age	Frequency	Valid percent	Cumulative percent
0-4	57	25.6	25.6
5-9	66	29.6	55.2

10-14	75	33.6	88.2
15-18	25	11.2	100.0
Total	223	100	

Laterality

Laterality	Frequency	Valid percent	Cumulative percent
OD(Right eye)	84	37.7	37.7
OS(Left eye)	119	53.4	91.1
OU(Both eyes)	20	9.0	100
Total	223	100	

Type of injury according to BETTS

Type of injury	Frequency	Valid percent	Cumulative percent
Closed Globe injury	171	76.7	76.7
Open globe injury	15	6.7	83.4
Chemical injury	10	4.5	87.9
Thermal injury	4	1.8	88.7
Non-globe injury	11	5.4	95.1
Mixed injury	12	4.9	100.0
Total	223	100	

Time of patient first visit

Time taken	Frequency	Valid frequency	Cumulative frequency
Same day	6	2.7	2.7
One day-One week	115	53.4	56.1

Two weeks	10	4.5	60.6
Three weeks	3	1.3	61.9
One month	11	4.9	66.8
Six weeks	1	0.4	67.2
Two months	5	2.2	69.4
Three months	3	1.3	70.7
Four months	1	0.4	71.1
Six months	2	0.9	72.0
Seven months	1	0.4	72.4
Nine months	1	0.4	72.8
One year	3	1.3	74.1
Two year	2	0.9	75.0
Unreliable memory	55	25.0	100.0
Total	223	100	

First aid/initial treatment used.

First aid	Frequency	Valid frequency	Cumulative frequency
Nothing used	131	58.0	58.0
Unknown GUTT	26	11.5	69.5
Gentamicin	15	6.6	76.1
Chloramphenicol	12	5.3	81.4
Breastmilk	6	2.7	84.1
TEM	12	5.3	89.4
Irrigation of cornea	1	0.4	89.8
Paracetamol	4	1.8	91.6
Diclofenac	1	0.4	92.0
Ivyflur	1	0.4	92.4
Eyemol	1	0.4	92.8

Ampiclox	2	0.9	93.7
Vitamin C	1	0.4	94.1
Cold compress	1	0.4	94.5
Ciprofloxacin	1	0.4	94.9
Betadone N	1	0.4	95.3
Chymoral	1	0.4	95.7
Tetnus injection	1	0.4	96.1
Ibruprofen	1	0.4	96.5
Gentalab	1	0.4	96.9
Visine	1	0.4	97.2
Cefuroxime	1	0.4	97.6
Chymotropin	1	0.4	98.2
Vitamin A	1	0.4	98.6
T mycin	1	0.4	99.6
Maxitrol	1	0.4	100.0
	226	100	

Initial visual acuity

Initial Visual Acuity	Frequency	Valid frequency	Cumulative frequency
VEP	14	6.8	6.8
6/4-6/6	66	29.6	36.4
6/9-6/18	51	22.9	59.3
6/24-6/48	8	3.6	62.9
6/60-3/60	13	5.8	68.7
<3/60-NLP	49	22.0	90.7
NON COMPLIANT	22	9.3	100

Total	223	100

Initial visual acuity*cause of pediatric ocular injury crosstab

	value	df	Asymptomatic significance (2-sided)
Pearson chi-square	106.308	60	0.000
Likelikood ratio	86.565	60	0.014
Linear-by-linear association	0.268	1	0.605
N of valid cases	223		

a. 67 cells (87.0%) have expected counts less than 5. The minimum expected count is 18.

Initial visual acuity*type of pediatric ocular injury crosstab

	value	df	Asymptomatic significance (2-sided)
Pearson chi-square	42.674[a]	30	0.063
Likelikood ratio	49.977	30	0.012

Linear-by-linear association	0.032	1	0.858
N of valid cases	223		

a. 35 cells (83.3%) have expected counts less than 5. The minimum expected count is 1.4.

Final visual acuity

Final Visual Acuity	Frequency	Valid frequency	Cumulative frequency
VEP	18	8.1	8.1
6/6	100	44.8	52.9
6/9-6/18	35	15.7	68.6
6/24-6/48	1	0.4	69.0
6/60-3/60	3	1.3	70.3
<3/60-NLP	23	10.3	80.6
LOST TO FOLLOW-UP	43	19.4	100.0
Total	223	100	

Trauma Index and severity

Trauma Index	Severity	Frequency	Valid frequency	Cumulative frequency
0-10	Mild	127	57.0	57.0
11-50	Moderate	50	22.4	79.4
>50	Lost to follow-up	46	20.6	100.0
Total		223	100	

Distribution of severity and gender

severity	Gender		Valid percent		Cumulative percent	
	Male	Female	Male	Female	Male	Female
Mild	78	49	69.02	76.6	69.0	76.6
Moderate	35	15	31.0	23.4	100.0	100.0
Total	177		100			

severity*gender crosstab

	Value	df	Asymptomatic significance (2-sided)
Pearson chi-square	1.145[a]	1	0.285
Likelikood ratio	0.803	1	0.370
Linear-by-linear association	1.165	1	0.286
N of valid cases	177		

a. 0 cells (0.0%) have expected counts less than 5. The minimum expected count is 18.08

severity*age group crosstab

	value	df	Asymptomatic significance (2-sided)

Pearson chi-square	0.852[a]	3	0.837
Likelikood ratio	0.855	3	0.836
Linear-by-linear association	0.325	1	0.569
N of valid cases	177		

a. 0 cells (0.0%) have expected counts less than five. The minimum expected count is 6.38

severity*type of injury crosstab

	value	df	Asymptomatic significance (2-sided)
Pearson chi-square	10.316[a]	5	0.067
Likelikood ratio	9.412	5	0.094
Linear-by-linear association	0.204	1	0.651
N of valid cases	177		

a. 7 cells (58.3%) have expected counts less than 5. The minimum expected count is 85

severity*initial visual acuity crosstab

	value	df	Asymptomatic significance (2-sided)
Pearson chi-square	118.035[a]	6	0.000
Likelikood ratio	125.744	6	0.014

Linear-by-linear association	54.475	1	0.605
N of valid cases	177		

a. 6 cells (42.9%) have expected counts less than 5. The minimum expected count is 0.85

Diagnosis	Frequency	Average time	Admitted
Corneal ulcer	77	2 weeks	No
Ocular trauma	27	1 week	No
Corneal foreign body	14	1 week	No
Sub-conjunctival hemorrhage	19	2 weeks	No
Superficial lid laceration	9	2 weeks	No
Traumatic cataract	8	4 weeks	No
Corneal abrasion	7	1 week	No
Corneal laceration	7	-	No
Traumatic conjunctivitis	6	1 week	No
Iris prolapse	5	-	No
Closed globe injury	5	2 weeks	No
Corneal scar	5	4 weeks	No
Traumatic uveitis	4	4 weeks	No
Blind eye	4	5 weeks	No
Traumatic keratitis	3	3 weeks	No
Conjunctival swelling	3	1 week	No
Hyperemia	3	1 week	No
Pre-orbital soft tissue injury	2	-	No
Ocular burn	2	2 weeks	No
Orbital fracture	1	-	No
Abraded sclera	1	-	No
Ectopic lentis	1	3 weeks	No
Ruptured globe	1	-	No
Lens subluxation	1	1 week	No
Vitreous hemorrhage	1	-	No
Conjunctival laceration	1	1 month	No
Deviation	1	-	No
Retrobulbar hemorrhage	1	Same day	No
Orbital cellulitis	3	1 month	No
Pre-orbital cellulitis	2	3 weeks	No
		I week	No

CAUSE				
		Frequency	Percent	Cumulative Percent
Valid	RUBBERBAND	5	2.2	2.2
	PENCIL/PEN	9	4.0	6.3
	FALLS	11	4.9	11.2
	CANE	11	4.9	16.1
	SELF INFLICTED	12	5.4	21.5
	FOREIGN BODY	12	5.4	26.9
	STONE	13	5.8	32.7
	BROOMSTICK	14	6.3	39.0
	PHYSICAL ASSUALT	32	14.3	53.4
	NOT KNOWN	44	19.6	73.1
	OTHERS	60	26.8	100.0
	Total	223	99.6	
Total		223	100.0	

PART OF THE EYE AFFECTED				
		Frequency	Valid Percent	Cumulative Percent
Valid	OTHERS	6	2.7	2.7
	ANTERIOR CHAMBER	7	3.1	5.8
	PUPIL&IRIS	9	4.0	9.9
	CRYSTALLINE LENS	12	5.4	15.2
	EYELID	21	9.4	24.7
	CONJUNCTIVA	40	17.9	42.6
	CORNEA	128	57.4	100.0
	Total	223	100.0	
Total		224		

AGE GROUP * GENDER Crosstabulation

Count				
		GENDER		Total
		MALE	FEMALE	
AGE GROUP	0-4	30	27	57
	5-9	44	22	66
	10-14	50	25	75
	15-18	15	10	25
Total		139	84	223

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.471[a]	3	.325
Likelihood Ratio	3.429	3	.330
Linear-by-Linear Association	1.164	1	.281
N of Valid Cases	223		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.42