PATTERN AND OUTCOME OF POSTERIOR SEGMENT INJURIES AFTER OCULAR TRAUMA AT THE VITREORETINAL UNIT IN KIKUYU EYE HOSPITAL

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DECLARATION

I declare that this dissertation is my original work and has not been presented for the award of a degree at any other university.

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DEDICATION

This work is dedicated to my family; my husband, Edgar, who has been my pillar and partner in life, my parents for their utmost sacrifice, my brothers Wachira and Ian for their endless love and prayers.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAO	American Academy of Ophthalmology
BCVA	Best Corrected Visual Acuity
BETT	Birmingham Eye Trauma Terminology
CI	Confidence Interval
HM	Hand Movement
IOFB	Intraocular Foreign Body
IQR	Interquartile Range
KEU	Kikuyu Eye Unit
KNH	Kenyatta National Hospital
LMIC	Low to Middle Income Countries
NPL	Not Perceiving Light
OTS	Ocular Trauma Score
OSU	Ophthalmic Services Units
PL	Perception of Light

PRP	Panretinal Photocoagulation
PVR	Proliferative Vitreoretinopathy
RPE	Retinal Pigment Epithelium
RTA	Road Traffic Accidents
RD	Retinal Detachment
SPSS	Statistical Package for Social Scientist
USA	United States of America
USEIR	United States Eye Injury Registry
VH	Vitreous Haemorrhage
VA	Visual Acuity
WHO	World Health Organisation

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ABSTRACT

Background

Ocular trauma is a significant cause of monocular blindness worldwide. Eye injuries involving the posterior segment have been a matter of concern particularly due to the related poor visual outcome. These injuries require specialised intervention and follow up care to achieve best possible visual outcome.

The study aimed to give baseline information on pattern of posterior segment eye injuries in our set up, visual outcomes, as well as the determinants of visual outcomes.

Study Objective

To review the pattern and outcome of posterior segment injury after ocular trauma at the vitreoretinal unit of Kikuyu Eye Unit.

Study Design

Retrospective case series of eye injuries involving posterior segment treated at Kikuyu Eye Unit, a tertiary referral Eye Hospital in Kenya.

Materials and Methods

A structured questionnaire was the main data collection tool from hospital records. Data was analysed using SPSS. Subject demographics, interventions done after injury as well as outcomes after interventions were analysed using appropriate statistical tests. A 95% confidence level was used.

Results

One hundred and six eyes of 102 patients were reviewed. Seventy three patients (71.6%) were male and majority were in the 31-40 years age group. The most known circumstance of injury was Road traffic accident in 9 patients (8.8%) with metal being the most common agent causing these injuries in 15 eyes (14.7%). Seventy nine eyes (74.5%) were closed globe injuries with retinal detachment and vitreous haemorrhage being the most common findings, at 49(46.2%) and 47 (44.3%) eyes respectively. Ninety nine eyes (92.5%) had surgical interventions done, with PPV and silicon oil fill done in 39 eyes (39.40%) which had retinal detachment. There was a marked improvement in the visual acuity from presentation and at final review after various interventions ($p<0.001$) with 39 eyes (37.9%) having a final visual acuity of 6/36 or better at final follow up. Retina was attached in 72.3% of eyes after retinal detachment surgery at final follow up. Eyes which had more number of surgical interventions

done had a higher chance of a worse visual outcome (p= 0.049).The median follow up time was 5 months.

Conclusion

Ocular injuries involving the posterior segment were most common in young males. Surgical and medical intervention is potentially vision saving in eyes with ocular injuries involving posterior segment with good outcome being achieved in eyes with extensive injuries.

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

1.1.1 Definition

Ocular trauma refers to injury to the eye. The injury may have been due to mechanical trauma (blunt or penetrating), chemical agents, or radiation (ultraviolet or ionizing) [1].
Posterior segment eye structures include the vitreous humour, retina, optic nerve and choroid. These injuries may include posterior segment blood vessel lacerations.
Kikuyu Eye Unit (KEU) is a tertiary eye care centre in central Kenya with subspecialists providing care for patients with trauma involving structures of the posterior segment.

A standardized terminology for eye injury, The Birmingham Eye Trauma Terminology (BETT) was developed based on extensive experience and repeated reviews. It has been endorsed by the Vitreous Society, the Retina Society, and the American Academy of Ophthalmology[2]. By always using the entire globe as the tissue of reference, classification is unambiguous, consistent and simple. It provides definitions for the commonly used eye trauma terminologies as follows;
Eye wall: This refers to the rigid structures of the sclera and cornea.

Closed globe injury: This is where the eyeball does not have a full thickness wound. Either there is no corneal or scleral wound at all (contusion) or it is only partial thickness (lamellar laceration)

Open globe injury: The eye wall has a full thickness wound. The cornea and/or sclera sustained a through and through injury. The choroid and the retina may be intact, prolapsed or damaged.

Rupture: A full thickness wound of the eyewall caused by a blunt object. The eyewall gives way at its weakest point whether at the impact site or elsewhere. The actual wound is produced by an inside-out mechanism and tissue prolapse is almost unavoidable.

Laceration: A full thickness wound of the eyeball, usually caused by a sharp object. The wound occurs at the impact site by an outside- in mechanism.

Penetrating injury: A single laceration of the eyewall, usually caused by a sharp object. No exit wound has occurred if more than one entrance wound is present because each wound must have been caused by a different agent.

Intraocular foreign body/ retained intraocular foreign body injury (IOFB): Retained foreign object(s) causing entrance laceration(s). An IOFB is a penetrating injury but grouped separately because of different clinical implications including treatment modality, timing, and endophthalmitis rate.

Perforating injury; two full thickness lacerations (entrance and exit) of the eyewall usually caused by a sharp object or missile. The two wounds must have been caused by the same agent.

This classification system categorizes ocular injuries at the time of initial examination. It is designed to promote the use of standard terminology and assessment with applications to clinical management and research studies regarding eye injuries.
In cases where injury occurs as a complex mechanism, the worst injury type is the one that best describes the consequences and implications of the case.

1.1.2 Predicting Visual Outcome after Ocular Trauma

The Ocular Trauma Score (OTS) is a system that was developed by United States Eye Injury Registry (USEIR) researchers and is used to predict final visual outcome after trauma. OTS is based on one functional (Vision Acuity) and five anatomical characteristics[3].

Table 1: Calculating OTS and predicting the visual outcome

Step 1;Determining the raw points	Variable	Raw point value
Initial Vision	NLP(No Light Perception)	60
	LP/HM(Light Perception/Hand Movement)	70
	1/200- 19/200	80
	20/200- 20/50	90
	≥20/40	100
Anatomical characteristics	Rupture	-23
	Endophthalmitis	-17
	Perforation	-14
	Retinal Detachment	-11
	RAPD (Relative Afferent Pupillary Defect)	-10

Table 2: Conversion of the raw points into the OTS, and identifying the likely visual outcome (%)

Likely Visual outcome in percentage (%)

Sum of raw points	0TS	NLP	LP/HM	1/200-19/200	20/200-20/50	≥20/40
0-44	1	74	15	7	3	1
45-65	2	27	26	18	15	15
66-80	3	2	11	15	31	41
81-91	4	1	2	3	22	73
92-100	5	0	1	1	5	94

If none of the five pathologies are present, the visual acuity determines the OTS

It is favourable since it is numerical therefore objective and reproducible. Data can be collected during the evaluation of the injured person or before surgery to allow the prognosis to be predicted.

The visual prognosis is more favourable when the primary mechanical damage caused by sharp penetration is limited to the anterior segment of the eye. Anterior segment structures include conjunctiva, cornea, anterior chamber, lens and anterior vitreous humour.

1.2: Literature Review

1.2.1: Mechanism of Tissue Injury after Trauma

Penetrating objects cause lacerations of the cornea, iris, lens, sclera, ciliary body, choroid, retina, and optic nerve, usually combined with anterior chamber, choroidal, subretinal and vitreous haemorrhages and occasional prolapse and incarceration of the lens, uvea, retina and vitreous[4].

Blunt trauma may cause damage to the eye by three mechanisms; coup, countercoup and ocular compression.

Coup refers to local damage at the site of impact whereas countercoup refers to injury at the opposite side of the eye caused by shock waves that traverse the eyeball with foci of tissue damage along the path of the shock waves[5].

Ocular compression may cause scleral rupture in eyes at areas of scleral weakness including the limbus, parallel to muscle insertions, between muscle insertions, the equator and at previous surgical scleral wounds[6].

Penetrating injuries involving the posterior segment carry a less favourable prognosis as compared to injuries involving the anterior segment[7,8]. The primary mechanical damage of vital structures by such injuries may be so great that useful vision is instantly destroyed[7].

The application of appropriate vitreoretinal surgery to prevent or treat secondary complications may result in the preservation of eyes that would otherwise be lost[9].

1.2.2 Statement of the Problem

Trauma is a major cause of disability worldwide and developing countries carry the heaviest burden, and they are the least able to afford the costs[10].

Kenya is an example of a Low to Middle Income Countries (LMIC) with an increasing burden of trauma especially with regard to road traffic accidents (RTA) [10].

Overall financial costs of treatment and rehabilitation can only be estimated as there is no local data on cost of inpatient treatment for eye trauma patients with posterior segment complications.

1.2.3 Epidemiology of Ocular Injuries

Worldwide, there are approximately 1.6 million people blind from eye injuries, 2.3 million with bilateral visual impairment and 19 million with unilateral vision loss[1]. The WHO Programme for the Prevention of Blindness estimates there are 200,000 open globe injuries a year[11]. In Kenya, eye injuries contributed to 2.7% of all ocular morbidity in 2010[12].

From selected worldwide publications, incidence of ocular trauma vary greatly depending on the study design as well as societal and geographical factors[13].

Kikira S. et al, in a study of 325 eyes at Kenyatta National Hospital (KNH),Kenya, found that posterior vitreous, retina and optic nerve injuries accounted for 12.7% of all blunt trauma eye injuries[14]. This was over duration of 17 months. In Egypt, a study by Soliman M over a period of six months found that out of one hundred and fifty three eyes, (2.5%) had vitreous haemorrhage with retinal detachment after blunt trauma[15].

There exist certain risk factors for ocular trauma including age, sex, and socioeconomic status.

The majority of those injured are young adults with an average age of around 30 years[3].

According to a descriptive study of emergency departments treating eye injuries in the United States of America, those sustaining a serious eye injury over the age of 60 years were observed to have different aetiologies as compared to those less than 60 years. The rate of fall was observed to be 23% if over 60 years as compared to 2% for those aged less than 60 years with a *p value* of <0.001. The rate of globe ruptures was reported at 31% for persons over 60 years as compared to 11% for those less than 60 years of age[16, 17].

The typical male: female ratio is 4:1 across all age groups in Kenya with assault and accidents accounting for majority of injuries in all age groups[14]. In the United States Eye Injury Registry (USEIR), 79% of all injured persons were male, representing a male to female ration of 3.8:1[17].

Soliman M in Egypt reported assault being the major cause of ocular trauma occurring mainly in males (80%) [15]. No particular societal risk factor has been identified in our setup and it would be of value to identify the groups at risk for targeted prevention strategies.

The site of ocular trauma in the USA is taking a shift from workplace to home-based injuries. This is due to laws enforcing the use of protective wear at the workplace and an increase in the number of elderly people living at home[5]. Assault is the cause of eye injury in 19% of injuries in the USEIR, 1% of which were self-inflicted[17].

In Kenya, Kikira S. et al observed low velocity missiles to account for the main aetiological factor[14]. High velocity missiles like dynamite and catapults accounted for fewer cases in comparison to Oluwole Omolase in Nigeria who found metallic objects to cause most of the injuries (21.2%)[18].

With regard therefore to available literature, cause of injury is largely dependent on the environment of the population studied and nature of their day to day activities[15,17, 18].

1.2.4 Posterior Segment Manifestation of Ocular Trauma

In trauma, posterior segment structures may be injured and this may assume different patterns differing from eye to eye.
Choroidal ruptures can occur after blunt trauma with either compression or contusion injuries, the incidence being 5-10% of all blunt ocular trauma[9].

Retina complications include retinal detachment, retinal dialysis, retinal tears and macula hole. Other reported retinal manifestations include chorioretinitis sclopetaria which describes chorioretinal injury from a high velocity projectile or vehicle to the orbit. At the time of this

acute injury, there is extensive retinal oedema and haemorrhage on clinical examination[6]. The clinicopathologic features show chorioretinal disruption followed by marked fibro vascular proliferation[19,20]. There is usually however no associated retinal detachment noted. This finding is attributed to spontaneous retinopexy and scar formation[21]. However, a recent case series of consecutive patients with retinal detachment in Boston, USA show associated chorioretinitis sclopetaria with retinal detachment[22]. The authors recommend that patients with traumatic chorioretinal rupture be monitored closely for the development of retinal detachment during the first few weeks after the injury.

A significant retinal manifestation after blunt trauma is Commotio Retinae which is characterized by white appearance of the retina. The white appearance can be at the peripheral retina or at the posterior pole[23]. When the retinal whitening involves the posterior pole then it is referred to as Berlin's oedema. According to a study done by Liem A.T et al, Berlin's oedema was accompanied by a traumatic lesion at the level of photoreceptor retinal pigment epithelium (RPE) complex and that such damage may be reversible[23]. Histologic studies have shown that the disruption of the photoreceptors outer segment may cause the opacity and lack of real oedema was noted in many cases[24].

Trauma is responsible for about 10% of all cases of retinal detachment and is the most common cause in children [9]. Blunt trauma causes the majority of traumatic retinal detachments (70-86%). A great variety of breaks may develop in traumatized eyes at the time of impact or subsequently. Eyes with scleral rupture after blunt trauma are often complicated by proliferative vitreoretinopathy (PVR).

PVR occurs frequently in injured eyes and is associated with poor outcomes[25,26]. Its onset depends on the interval between injury and vitrectomy, wound location, vitreous haemorrhage and retinal detachment[25]. In a recent study done where patients were selected from the database of the Eye Injury Vitrectomy Study (a multicentre cohort study launched in 1997), 179 eyes with PVR and 221 eyes without PVR after injury were assessed. It was established that early vitrectomy, that is before 2 weeks was noted to reduce the chances of PVR[25]. Traumatic retinal detachments occur primarily as the result of retinal changes at the vitreous base[27]. These types of

retinal detachments are mostly caused by retinal dialyses and giant retinal tears. Giant retinal tears are retinal breaks that extend three or more clock hours of the eyeball which is ninety degrees or grater in the peripheral retina[28]. A retinal dialysis is a discontinuity or separation of the retina from the pars plana at the ora serrata[27].

In open globe injuries, traumatic tractional retinal detachment results from vitreous incarceration at wound site with resultant fibrous proliferation along the plane of incarcerated vitreous and subsequently an anterior retinal detachment[29].

Haemorrhages to the posterior segment seldom appear isolated. They may be classified as vitreous haemorrhage, subhyaloid haemorrhage, retinal haemorrhage, subretinal haemorrhage, choroidal haemorrhage, papillary and peripapillary haemorrhages. Vitreous haemorrhages vary in size, location and density[30]. Vitreous haemorrhage grading has been utilized in two major clinical trials by vitrase for vitreous study[30,31] with excellent clinical and photographic reproducibility. It is based on visibility of the underlying retina as follows;

Grade 0: No blood is present in the vitreous, and the entire retina is visible.

Grade 1: Some haemorrhage is present, which obscures between a total of 1 to 5 clock hours of retina. Laser photocoagulation can be successfully performed

Grade 2: Haemorrhage obscures between a total of 5 to 10 clock hours of central and/or peripheral retina, or a large haemorrhage which is located posterior to the equator, with varying clock hours of anterior retina visible. Laser is feasible, but a full pan retinal photocoagulation (PRP) cannot be placed

Grade 3: A red reflex is present, with no retinal detail seen posterior to the equator, precluding any photocoagulation.

Grade 4: Dense Vitreous haemorrhage with no red reflex present

Thirty two percent (32%) of all intraocular foreign bodies are located in the anterior segment. Fifteen percent (15%) of intraocular magnetic foreign bodies are found in the anterior chamber, 8% in the lens, 70% in the posterior segment and 7% in the orbit as a result of globe perforation[9]. Ultrasound B Scan can accurately localize intraocular foreign bodies[32]. However due to lack of diagnostic equipment in most of the eye units in Kenya, X-ray films may be used to localize foreign bodies as well. This can be more useful when combined with a Comberg lens technique. This technique involves use of a contact lens containing four lead dots which is placed on the eye and postero-anterior and lateral films are taken to relate the foreign body to the four dots. This is a precise and accurate technique of localization of intraocular foreign bodies[33].

1.2.5 Management of Posterior segment Traumatic Injuries

Successful management of trauma requires meeting several specific objectives. These include maintaining a clear visual axis if possible and avoiding long-term ocular and systemic complications

The treatment options for retinal breaks and detachments secondary to trauma vary but include laser retinopexy, cryopexy, pneumatic retinopexy, scleral buckle, pars plana vitrectomy, or a combination of these treatments[6]. The prognosis depends on the extent and duration of the retinal break or detachment and any other associated ocular injuries or co-morbidities.

Giant retinal tears and retinal dialysis are treated with scleral buckling or pars plana vitrectomy[28]. As previously mentioned, most of trauma victims are young with a solid vitreous, providing internal tamponade to the retina despite retinal tears or dialyses. However, with age, the vitreous liquefies, allowing fluid to form in the vitreous cavity, which can pass through the retinal breaks and detach the retina. This then warrants long term follow up to pick any late development of retinal detachment. Traumatic retinal detachments are treated primarily by scleral buckling.

Three port pars-plana vitrectomy with wide field visualization is the standard method of management of complex posterior segment ocular trauma[34,35]. It is also indicated for persistent vitreous haemorrhages or vitreous haemorrhage with associated retinal detachment or presence of retinal tears[36].

However there are several technical considerations in surgical repair including timing, presence of infection and other systemic complications. The objectives during vitrectomy include removal of blood to allow visualization of retina and creation of a posterior vitreous detachment. Once all traction from vitreous or pre- retinal membranes is relieved the retina can be flattened. The retina is flattened with air- fluid exchange or use of perfluorocarbon liquids. Perfluorocarbon liquid is often preferable in trauma cases due to easier visualization of the retina during the application of retinopexy. Endolaser or indirect laser is then applied to any retinal breaks observed[37].

Intraocular foreign body (IOFB) removal via direct visualization is the preferred method for IOFB removal to avoid secondary iatrogenic trauma. Removal of IOFB is recommended at the time of repair of the entry site or soon afterwards as soon as corneal clarity permits[6]. Pars plana vitrectomy is indicated for invisible IOFB with opaque media because of cataract or vitreous haemorrhage, large, posterior, nonmagnetic, intraretinal or subretinal IOFB's as well as IOFBs associated with retinal detachment and endophthalmitis.

Secondary complications of ocular trauma include the toxic effects of IOFB like copper and iron which cause chalcosis and siderosis respectively, introduction of bacteria and fungi with consequent infectious endophthalmitis.

1.2.6 Outcome of Posterior Segment Injuries

Some factors have been found to influence the final visual outcome after ocular trauma. These include time interval between injury and visit to the hospital, wound location with a more posterior wound having a poor visual outcome, initial visual acuity, and OTS[38]. Qi Y et al[39], in a large retrospective study of 5964 eyes of 5799 patients hospitalized for ocular trauma in central China from 2006 to 2011 showed that the sensitivity of OTS in predicting vision outcome of presenting vision acuities of NPL, between 20/200 to 20/50, and ≥ 20/40 was 100%. On the other hand, the specificity of OTS in predicting vision at PL/HM, 1/200-19/200 was 100%.
In regard to posterior segment injuries post operatively, outcome can be anatomic or functionally successful[40]. Anatomic success is defined as eyes with attached retina and generally clear media, regardless of visual function.

Functional success is defined in most studies as eye with a final visual acuity of 20/100 or better, or a postoperative improvement in visual acuity of two lines on the Snellen Chart[40]. Poor visual outcome has been defined as visual acuity worse or <5/200[41]. The main reasons for poor visual outcome are presenting visual acuity, defects of the macula, retinal detachment, delayed intervention, PVR and endophthalmitis[41,42]. PVR has been reported in 10-44% of eyes following posterior segment penetrating injury[25].

Erdurman FC et al found 71.3% of eyes with posterior segment injuries from ocular contusion with final VA of 20/100 or better after treatment. Retinal attachment was achieved in 69% of cases with retinal detachment after primary vitreoretinal surgery in contusion injuries[40]. Functional success was achieved at 33% in patients with retinal detachment. This is comparable to other retrospective case series studies that found anatomic success rate of between 68-70%[41, 42,43].

Vitreoretinal surgery can improve anatomical and functional success in eyes with retinal detachment[38]. Recent studies have favoured scleral buckling to prevent post-operative retinal detachment in both open and closed globe injuries[44,45].

Ersani et al however reported that scleral buckling procedure might not be necessary for cases of severe closed globe injuries involving the posterior chamber[43].

Warrasak S et al in a study of ninety-two patients (94 eyes) with open globe ocular injuries involving posterior segment in Thailand, found sharp perforating ocular injuries types to have the best visual prognosis[42]. This is comparable to other studies involving open globe injuries[46]. Twenty-three of 38 eyes (60.53%) that had sharp perforating injuries with retained IOFBs achieved a visual acuity of 20/70 or better after PPV.

Traumatic macula hole surgeries have also been reported to have equally comparative visual outcomes to traumatic retinal detachment surgery[47]. One study reported functional success in 69% of eyes[48]. Anatomic success is reported to be higher between 70-92%[47- 49].

CHAPTER TWO: STUDY JUSTIFICATION

2.1 Study Rationale

The study is aimed at providing baseline information on the pattern of posterior segment manifestations after ocular trauma in the region.

The study will also provide information on outcome of posterior segment injuries in a standard vitreoretinal set up in our country.

The study will also act as an audit to affirm, guide or change current clinical practice with regard to patients presenting with ocular injuries involving the posterior segment.

This may contribute to the setting of protocols for posterior segment trauma eye care services.

World Health Assembly's 2007 Resolution number 60.22(Health Systems Emergency –Care Systems) called on national governments and the World Health Organization to strengthen trauma care globally. One way would be to have local data on impact of eye morbidity by trauma.

CHAPTER THREE: OBJECTIVES

3.1 Main Objective

To review the pattern and outcome of posterior segment injuries after ocular trauma as seen at the vitreoretinal unit at Kikuyu Eye Unit

3.2 Secondary Objectives

- To describe the cause and clinical presentation of posterior segment injuries
- To describe types of interventions
- To determine outcomes after intervention
- To describe factors that determine the visual outcome

CHAPTER FOUR: MATERIALS AND METHODS

4.1 Study Design

This was a retrospective case series

4.2 Study Location

Kikuyu Eye Unit, which is part of the larger Presbyterian Church of East Africa (P.C.E.A) Kikuyu Hospital, is located about 30km from Nairobi city in Kenya. It serves as one of the few referral centres in the country for vitreoretinal surgery and also a University of Nairobi collaborative centre.

It is a busy eye unit catering for about 3500-5000 patients in a month. Approximately 5 posterior segment injuries of the eye are treated every month.

4.3 Study Population

All patients with ocular trauma involving posterior segment structures seen in KEU's vitreoretinal unit between 1st January 2010 and 31st December 2014

4.4 Study Materials

- Theatre lists from KEU
- Patients files from the records department at KEU
- Self-structured questionnaire
- Excel data entry sheet

PERSONNEL

- Principal investigator
- Theatre records in charge at KEU
- Records clerk at KEU
- Statistician
- Research assistants, 2 ophthalmic clinical officers, to help in data collection

4.5 Case Definition

Patient seen in KEU Vitreoretinal unit with ocular trauma involving posterior segment between January 2010 and December 2014, and have had a clear ocular media.

4.6 Exclusion Criteria

Severe anterior segment injuries precluding posterior segment examination

Missing records

4.7 Sample Size Calculation

According to a previous study done in KNH, 12.7% of 325 eyes recorded over 17 months were involving posterior segment parts[14]. This implies that an estimated 150 posterior ocular injuries was likely to be available over 5 years (from January 2010 to December 2014). A representative sample would be drawn from the population in the period and the sample size calculation was obtained using the formula for finite population (Daniel, 1999). The calculation is as follows:

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)}$$

Where

n' = sample size with finite population correction,

N = size of the target population = 150

Z = Z statistic for 95% level of confidence = 1.96

P = Estimated proportion of patients who achieved good visual acuity outcome after intervention= 71% (Erdurman et al, 2011)[40]

d = margin of error = 5%

$$= \frac{150 \text{x } 1.96^2 \text{ x } 0.71 \text{ x } 0.29}{0.05^2 \text{ (150-1)} + 1.96^2 \text{ x } 0.71 \text{ x } 0.29}$$

=102 eyes with posterior segment ocular injuries

All files of patients with posterior segment injuries however were included.

4.8 Data Collection and Analysis

The list of all ocular trauma cases was identified by finding in the computer at the medical records department in Kikuyu Eye Unit the ICD-10 code for eye injuries.

This list showed the name, age, year of receiving medical attention or hospitalization and in patient (IP) number. The corresponding patients' hospital files were retrieved from the records department with the help of the hospital's records clerk.

Additional records were sought from the hospital's theatre register to identify patients who had been operated on in the vitreoretinal theatre as a result of trauma.

All patients whose eyes sustained posterior segment injuries within the study period and who meet the inclusion criteria were identified on perusal of the files by the principal investigator as well as the research assistants. Their relevant data was entered in a pre-designed questionnaire on perusal of the medical records and then entered in MS Excel spread sheet.

Data collection was over duration of 3 months.

Data evaluation was done as follows;

1. Demographic details: age, gender, county of residence
2. Evaluation of clinical features at presentation, date of injury and of presentation to Kikuyu Eye Unit, as well as time taken before presentation.
3. Date of presentation at primary health point, and any management done prior if the patient is a referral.
4. Distinguishing how many cases required intervention from those that were observed as indicated by the nature and extent of injury.
5. Evaluation of interventions done from theatre records and patients' files.
6. Outcome in terms of Snellen best corrected visual acuity (BCVA) and Fundoscopy findings on follow up at 1st post-operative day, on subsequent post-operative visits and at final follow up.

Statistical analysis was done using SPSS version 21.0. The study population was described by summarizing the demographic and clinical characteristics into means/medians and percentages for continuous and categorical variables respectively. Definitive interventions were analysed and presented as percentage number of patients receiving a specific type of intervention. Outcomes were measured using visual acuity in the final assessment of the patient. Anatomical outcomes were analysed and presented as proportions. Determinants of final visual outcome were analysed to compare mean or median time between injury and presentation, duration of follow up, status of the globe, whether closed or open and number of interventions performed with the final visual outcome.

The median differences of duration of injury, duration of follow up and the number of interventions were tested across the different levels of visual outcomes using Kruskal Wallis test. Open or closed globe was associated with visual outcome using Chi square test.

Wilcoxon signed rank test was used to test associations between the final visual outcome and initial VA. All statistical tests were conducted at 5% level of significance.

4.9 Main Outcome Measures

Outcomes (visual acuity and anatomical) of patients with ocular trauma involving posterior segment

Prognostic indicators of outcome

4.10 Ethical Consideration

Ethical approval was obtained from the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee (KNH/UON-ERC). Permission was also obtained from P.C.E.A Kikuyu Hospital to undertake the study.

Patients' confidentiality was strictly observed by coding patients' names and these codes were subsequently used for reference, analysis and presentation of the findings of this study.

The data and information was only available to the investigators and the statisticians.

All raw data, both hard and soft was destroyed after results presentation.

4.11 Study Period

Table 3: Study Period

Tasks	**Date**
Proposal Preparation, Presentation and Department Approval	January 2015 to June 2015
Submission of Proposal for Ethical Approval	September 2015
Data Collection	September to November 2015
Data Analysis	November 2015
Report Writing	December 2015
Results Presentation	February 2016
Submission of Dissertation	May 2016

CHAPTER FIVE: RESULTS

Figure 1: Flow Chart of Records of Patients Seen at KEU

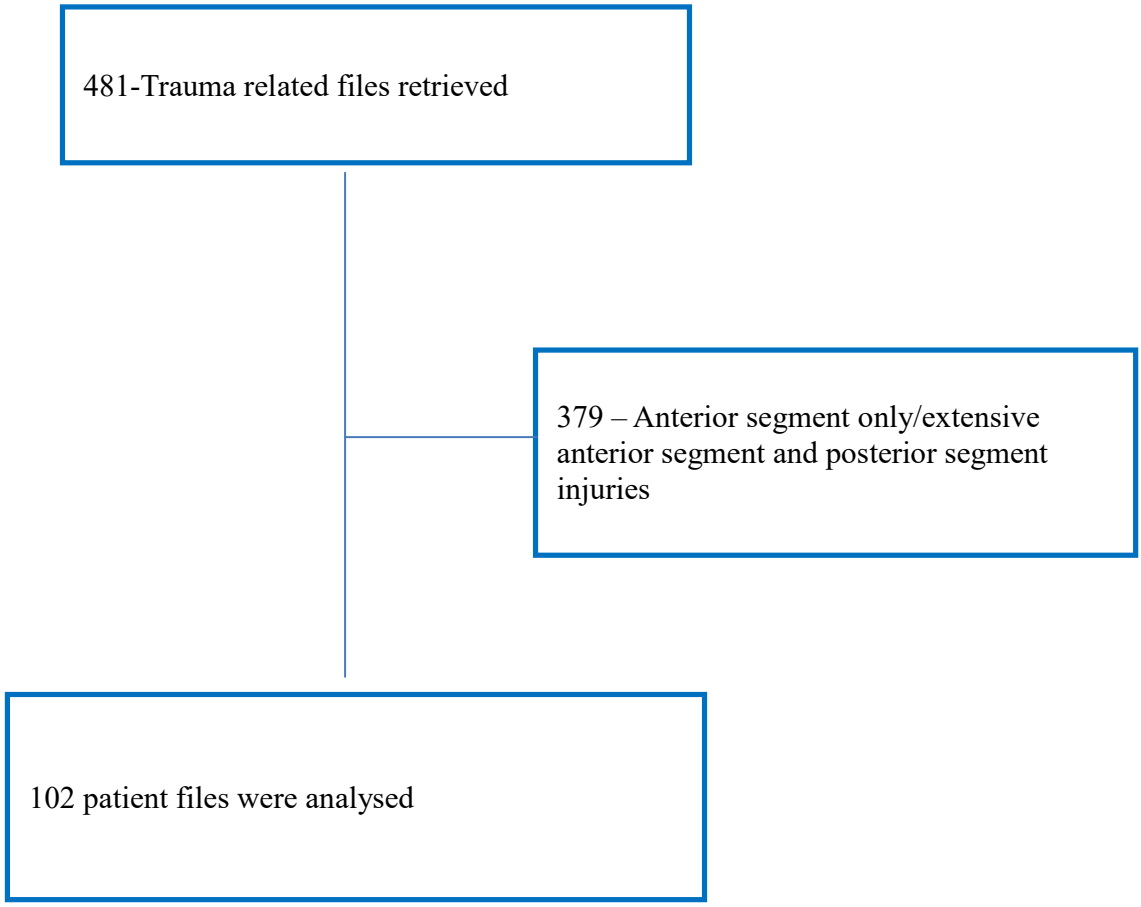
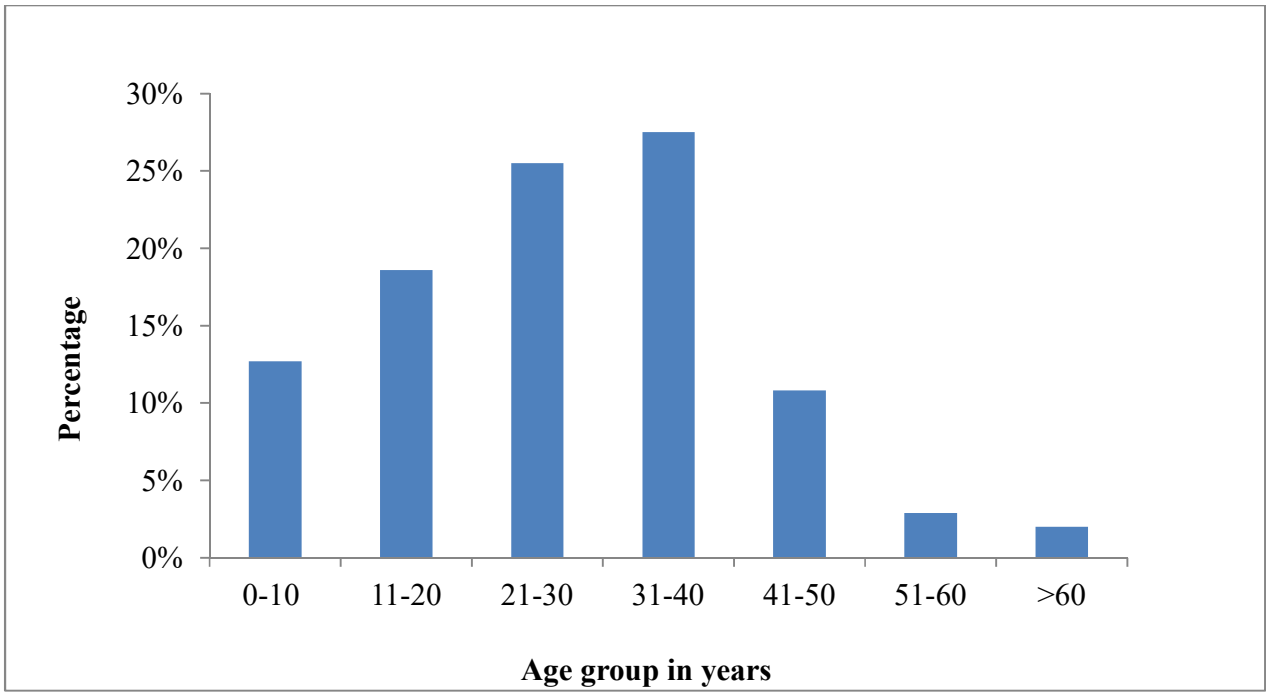


Table 4: Distribution by Sex (n=102)

Variable	Frequency (%)	95% CI
Sex		
Male	73 (71.6%)	62.7-80.4
Female	29 (28.4%)	19.6-37.3

As there was no overlap between the confidence interval of the two categories (male vs female patients), the difference was statistically significant.This points to a male preponderance to ocular trauma involving the posterior segment.

Figure 2: Distribution of Patients by Age



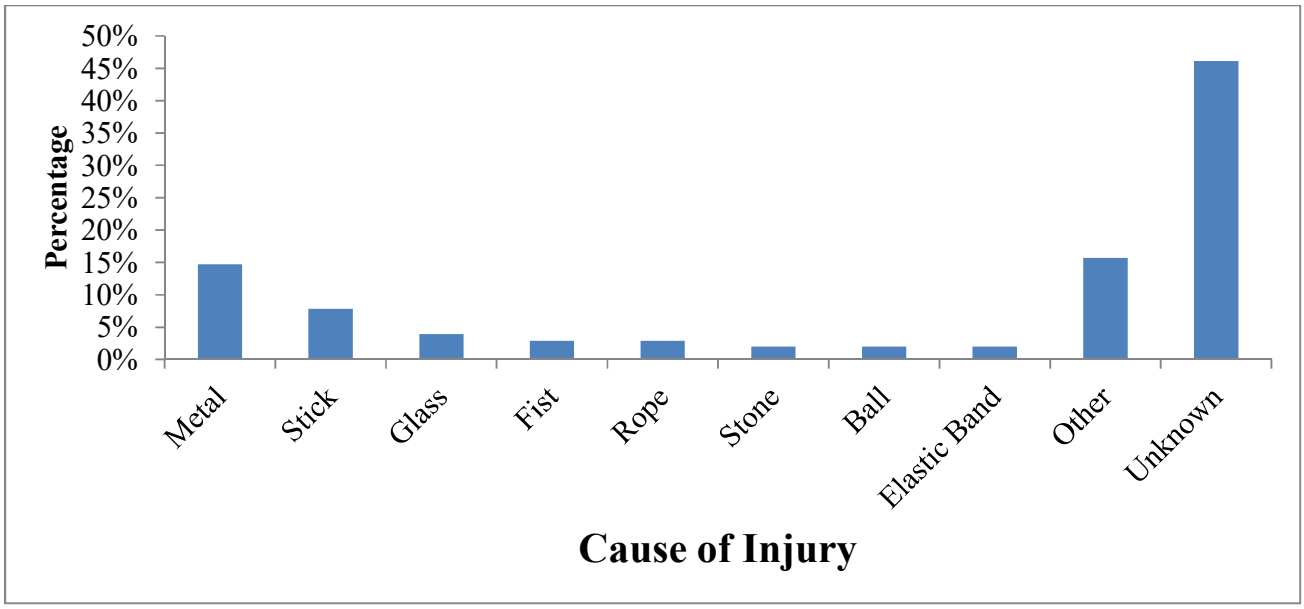
The mean age of patients was 27.8 ± 14.3 years (range 1-68 years). The age group most affected was 31-40 years (27.5%) followed by 21-30 years (25.5%). The risk of injury appears to reduce after the fifth decade of life.

Table 5: Frequency of Eye Affected (n=102)

Eye affected	Frequency	95% CI
Right Eye	48 (47.1)	37.3-57.8
Left Eye	50 (49.0)	39.2-59.8
Both Eyes	4 (3.9)	1.0-7.8

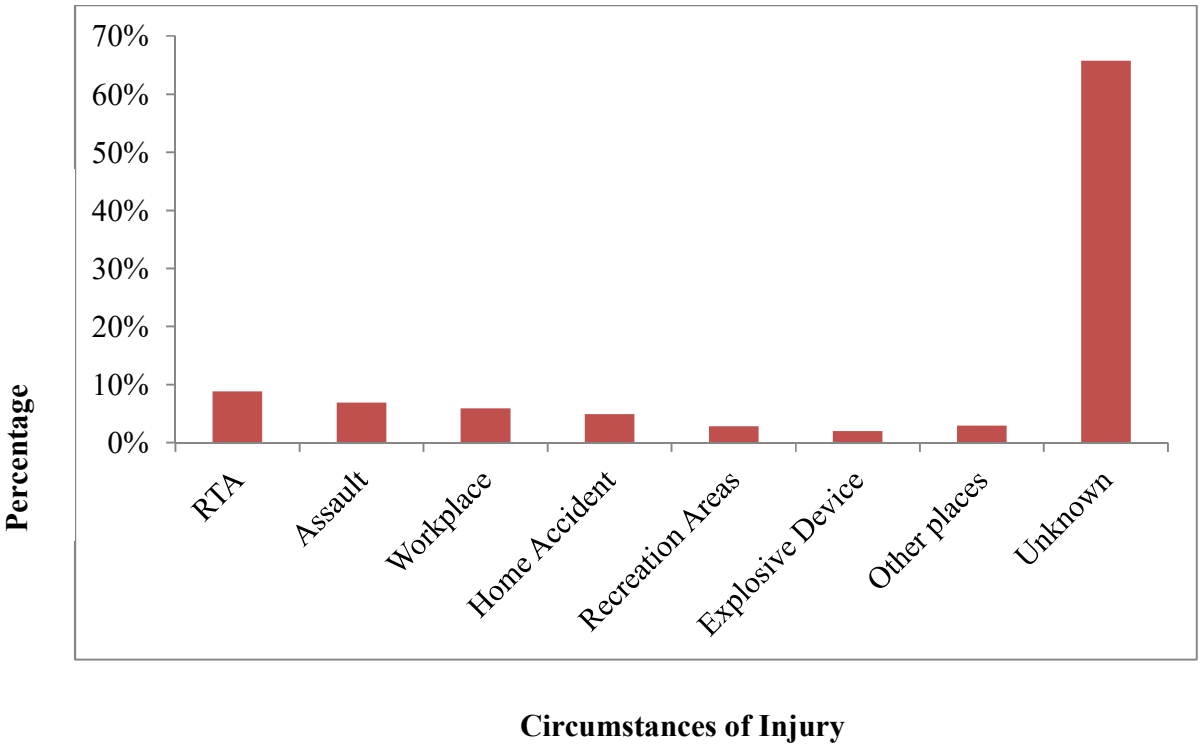
There was slightly higher involvement of the left eye in the patients seen (95% CI37.3-57.8), but this was not statistically significant.

Figure 3: Cause of Injury (n=102)



Nearly half (46.10%) of eyes did not have the cause of injury recorded. Out of the recorded causes, the commonest was metal.

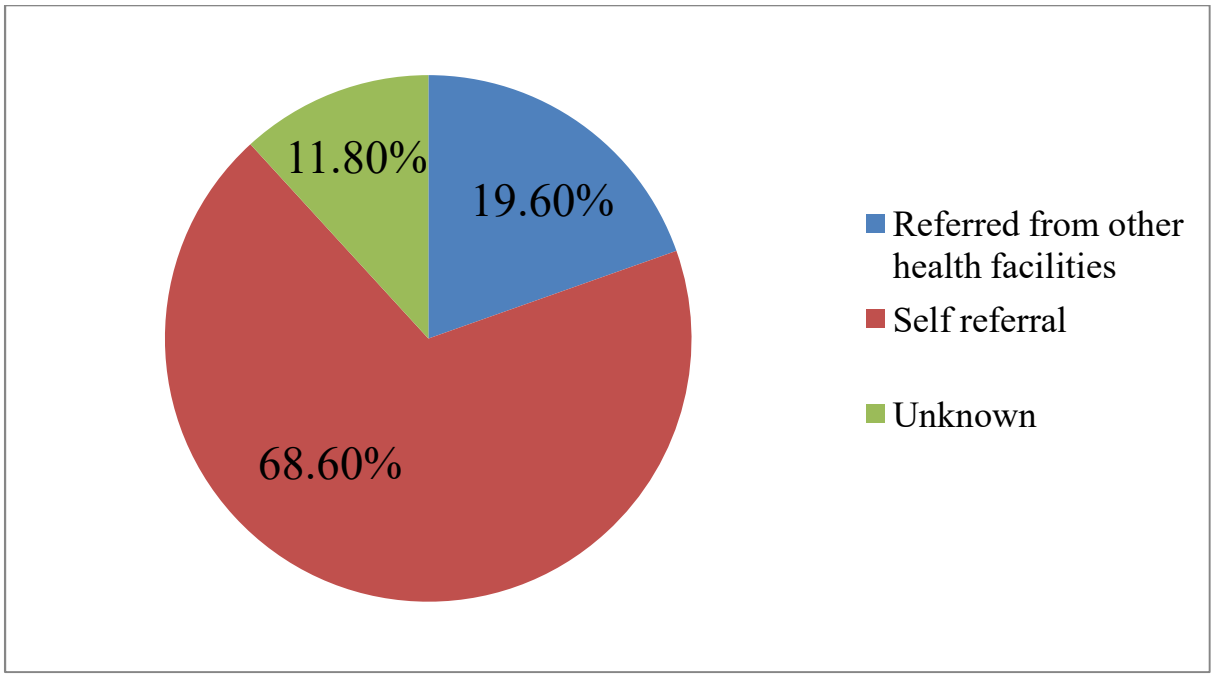
Figure 4: Circumstances of Injury among patients (n=102)



Circumstance of injury in most patients was not recorded.

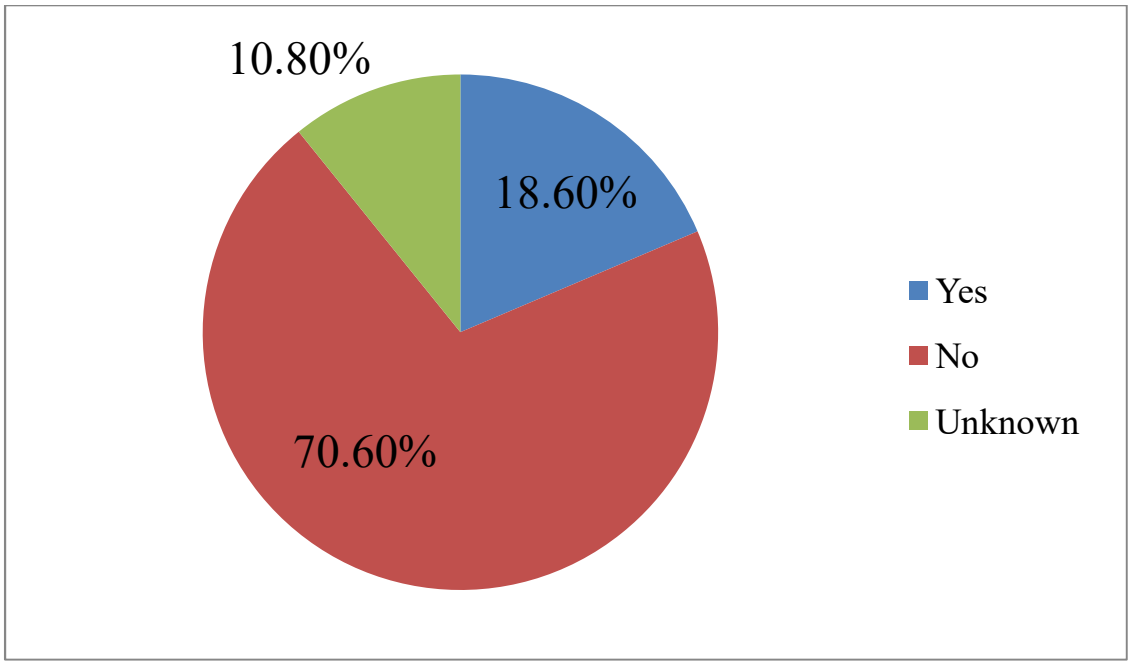
Out of the records where the nature of injury was noted, the most common was through Road Traffic Accident (8.8%), followed by assault (6.9%).

Figure 5: Referral pattern of patients presenting to KEU Vitreoretinal Unit



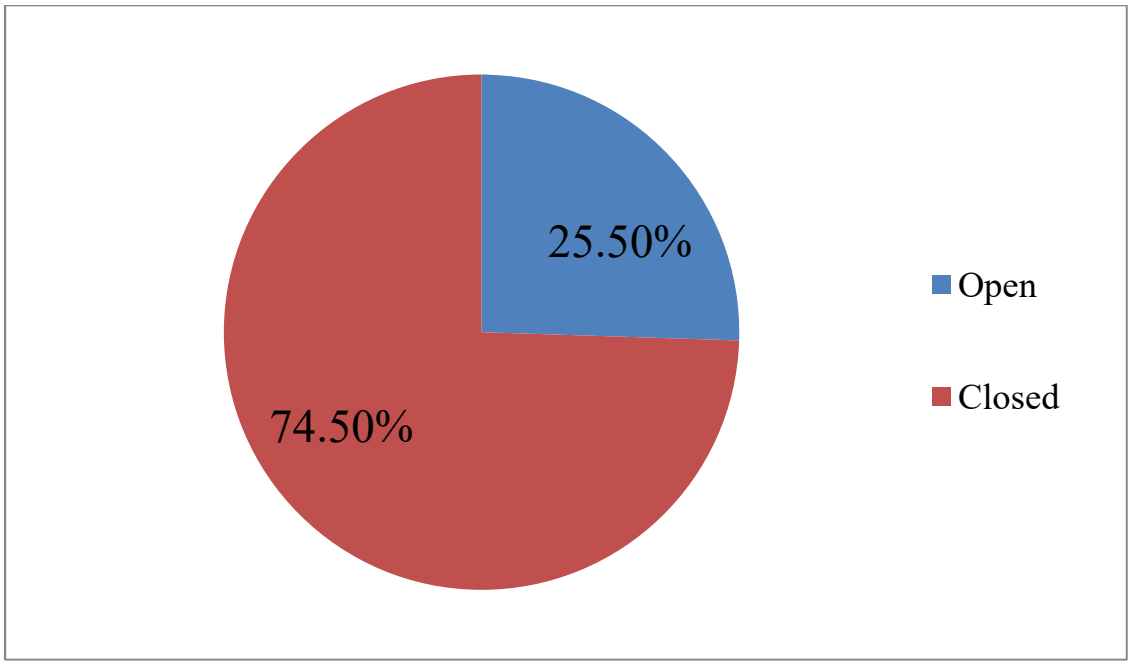
Seventy (68.60%) patients were self-referral while 20 (19.60%) patients were referred from other health facilities.

Figure 6: Profile of Patients who had prior treatment (n=102)



Seventy two (70.6%) patients did not have treatment as compared to 19(18.6%) who had received treatment prior to presenting at KEU.

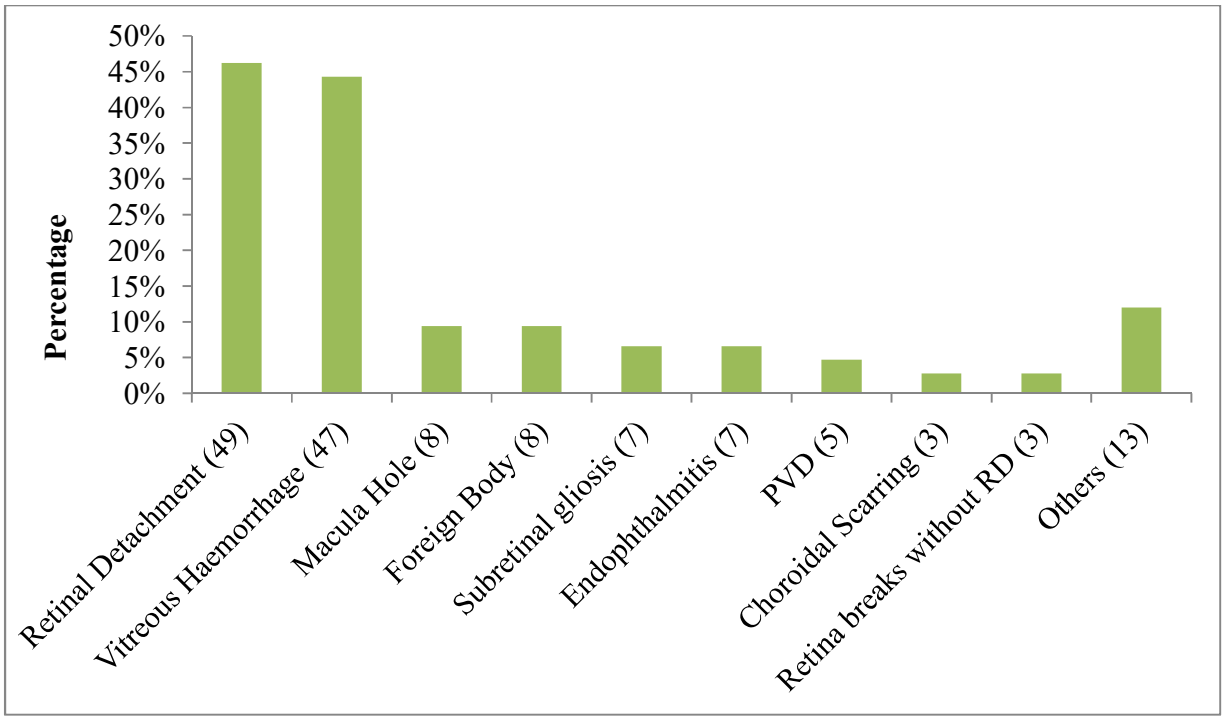
Figure 7: Globe Status after Injury (n=106)



Seventy nine (74.5%) eyes had closed globe injury.

Fifty one eyes, (48.1%) had anterior segment involvement alongside posterior segment injury. However, only those with an accessible posterior segment (either by clinical examination or by ultrasound scan) were included in the study.

Figure 8: Posterior Segment Findings at Presentation after Ocular Injury



Finding in Posterior segment (n)

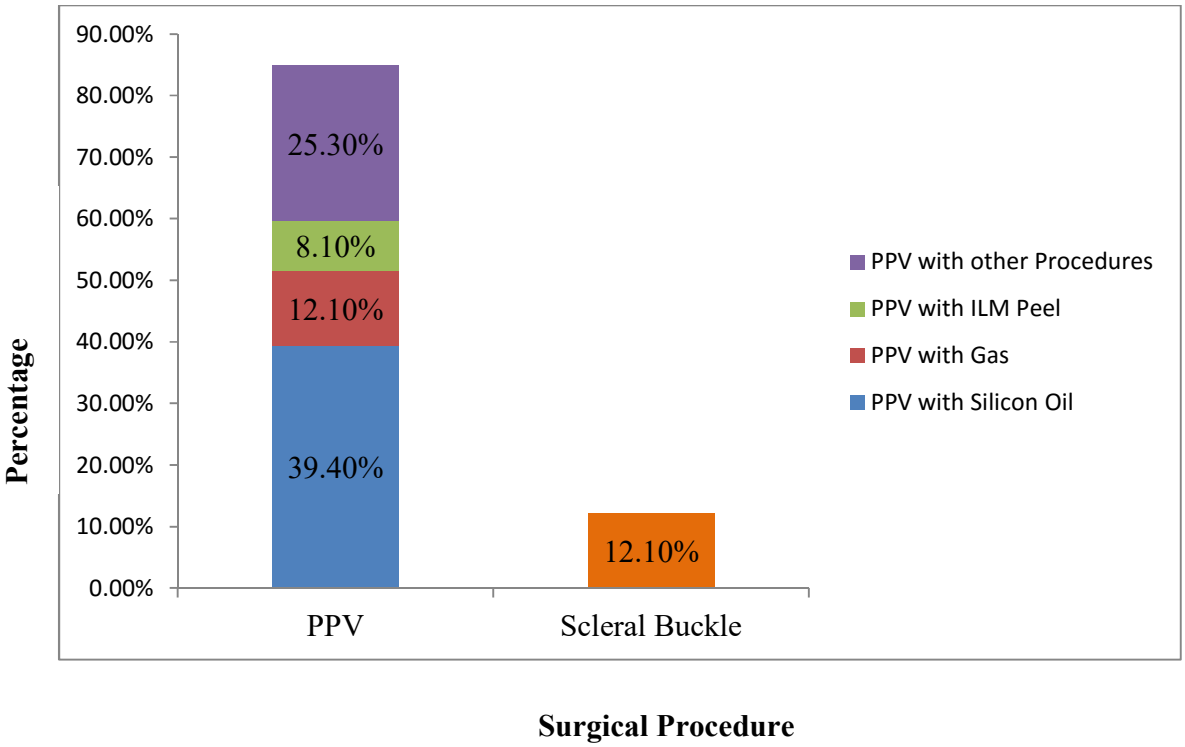
Retinal detachment was the most observed finding in 49 (46.2%) eyes and vitreous haemorrhage in 47 (44.3%) eyes. Most patients had more than one finding in the same eye.

Table 6: Modalities of Intervention Offered at KEU (n=106)

Treatment modality	**Frequency in Percentage**
Surgical	99 (92.5%)
Observation	14 (13.1%)
Medical	11 (10.3%)
Lost to follow up	2 (1.9%)

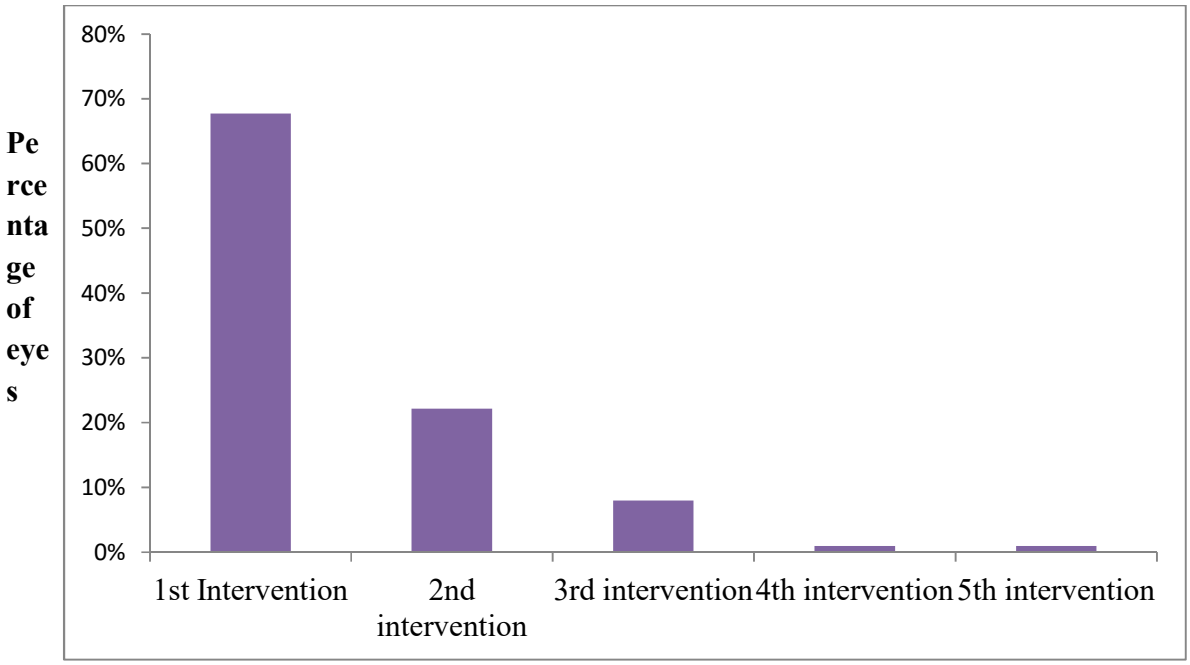
The most common type of intervention offered was surgical for 99 eyes (92.5%).

Figure 9: Surgical Procedures Performed (n=99)



The most common surgical procedure performed was PPV with silicon oil fill in 39 eyes (39.40%). This procedure was done for retinal detachment.

Figure 10: Number of surgical interventions (n=99)



Most eyes (67) had one surgical intervention performed.

Table 7: Visual Acuity at presentation

Presenting VA in the Injured Eye	**Frequency (n=106)**
6/6 -6/18	3 (2.8%)
<6/18-6/60	9(8.5%)
<6/60- 3/60	5(4.7%)
<3/60	89(84.0%)

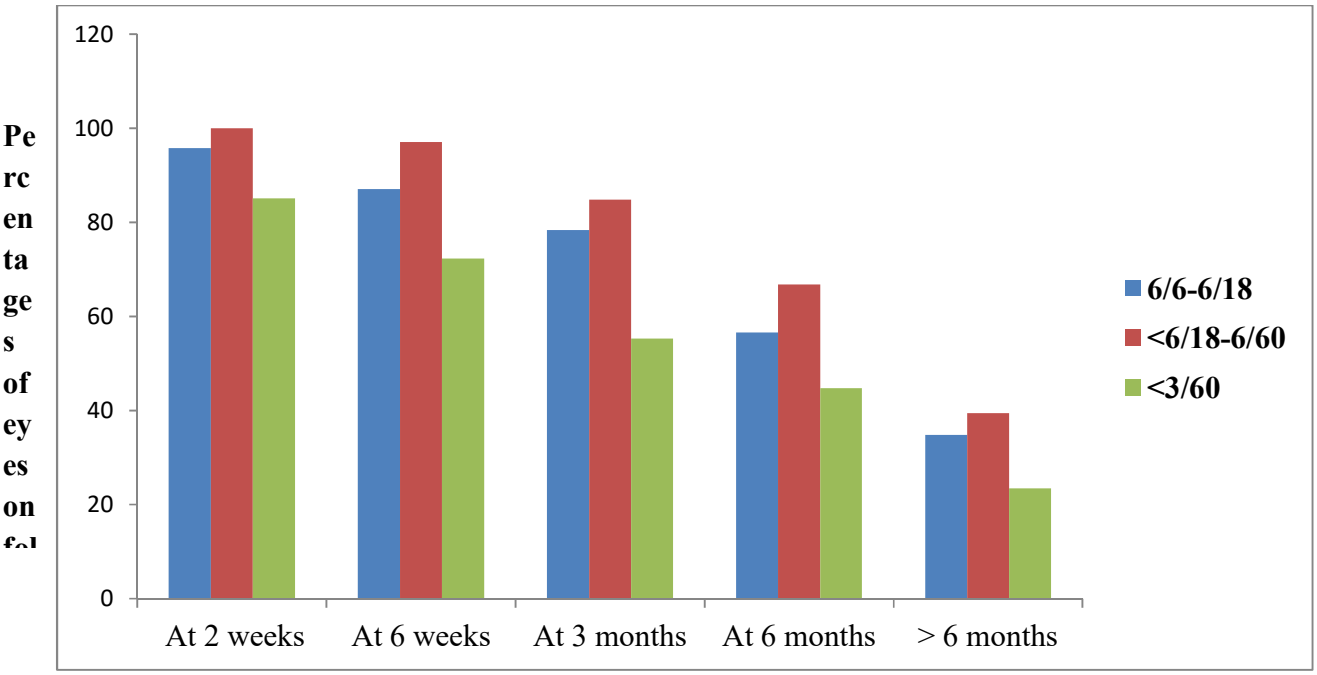
Majority of eyes (84.0%) with posterior segment injury were found to be blind at presentation (<3/60).

Table 8: Visual Acuity Before and After Various Modalities of Intervention

VA of the injured eye	Number of eyes (n=103)		Working p value of <0.05
	At presentation	At final assessment	
6/6-6/18	3 (2.8%)	23 (22.3%)	<0.001
<6/18-6/60	9 (8.5%)	33 (32.0%)	
<6/60-3/60	5 (4.6%)	0 (0.0%)	
<3/60	86 (83.5%)	47 (45.6%)	

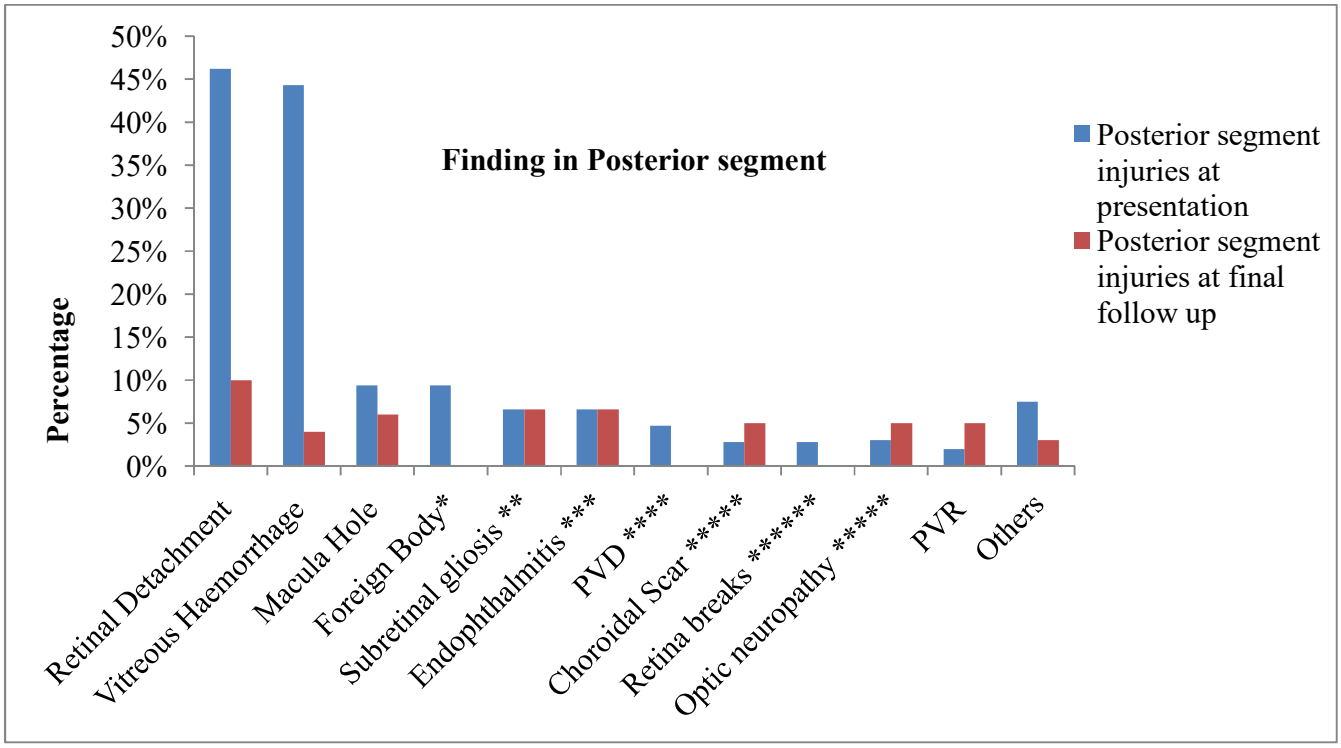
There was a marked improvement in the visual acuity from presentation and at final review after various interventions ($p<0.001$)

Figure 11: Follow up Profile of Eyes as per Final VA



There was a high post intervention loss to follow up with time in all categories of visual acuity.

Figure 12: Comparison of Posterior Segment Findings at Presentation and at Final Follow Up



Most of the eyes that had retinal detachment, 34(72.3%) of them had retina attached at final follow up.

6 (75%) of the eyes with macula hole had macula hole closure.

*All foreign bodies were extracted

**There was no new subretinal gliosis in other eyes after follow up.

***There was no improvement in the 7 eyes with endophthalmitis at final follow up

****The eyes with PVD at presentation underwent vitrectomy for the associated primary surgical indication for surgery

*****Choroidal scarring and optic neuropathy became more evident after the ocular media cleared following surgical intervention.

******Eyes with retinal breaks after surgery subsequently developed RD

Table 9: Associations of Various variables with visual outcome

Variable	**6/6-6/18**	**<6/18-6/60**	**<3/60**	**Working p value <0.05**
Duration of injury in days, median (IQR)	30 (13-150)	29 (10-180)	30 (6-360)	0.546
Duration of follow up in months, median (IQR)	5 (2-10)	6 (2-8)	3 (0.5-6)	0.288
Globe				
Open	5 (20.8)	4 (16.7)	15 (62.5)	0.097
Closed	16 (25.4)	23 (36.5)	24 (38.1)	
Number of surgical interventions, median (IQR)	1 (1-1)	1 (1-2)		0.049

Eyes which had more number of surgical interventions done had a higher chance of poorer visual outcome (p= 0.049).There was no statistically significant difference in duration of injury, duration of follow up, status of the globe, whether closed or open with the final visual outcome.

Table 10: Comparison of Visual Acuity Outcome to OTS

		Visual Acuity				
OTS Score	Number of Patients	NPL	LP/HM	1/60 - <6/60	6/60 - <6/12	≥6/12
1	n=2	50	50	0	0	0
2	n=15	6.7	33.3	20.0	13.3	26.7
3	n=28	3.6	21.4	10.7	50.0	14.3
4	n=3	0	33.3	0	33.3	33.3
5		0	0	0	0	0

Only 48 patients had an OTS score details that could be retrieved from the file. The findings were comparable to the OTS score developed by United States Eye Injury Registry (USEIR) below.

	Visual Acuity				
0TS	NLP	LP/HM	1/200- 19/200	20/200-20/50	≥20/40
1	74	15	7	3	1
2	27	26	18	15	15
3	2	11	15	31	41
4	1	2	3	22	73
5	0	1	1	5	94

CHAPTER SIX: DISCUSSION

6.1 Patient Demographic Characteristics

The study involved 106 eyes of 102 patients (Fig. 1) in the period from January 2010 to December 2014.

Of these patients, 73 (71.6%) were male as compared to 29 (28.4%) female patients and the difference was statistically significant as the confidence intervals were not overlapping. The male to female ratio was 2.5:1.This shows a male preponderance to injuries of the posterior segment. This finding is attributed to the social and professional activities that males are likely to be involved in that put them at a higher risk of injury. This compares to other eye injury studies done in our country. Momanyi et al in Kenya found a male to female ratio of 2.5:1 [50], while Kikira et al found a ratio of 4:1 [14]. According to the USEIR, the male to female ratio is 3.8:1 indicating that even in the developed world males are more likely to get eye injuries than females[17].

The age group most affected by injuries involving the posterior segment was between 31-40 years (27.5%) followed closely by the age group between 21-30 years (25.5%). The mean age was 27.8 years (range 1-68 years). There were 25 children included in the study. This was similar to other studies for posterior segment ocular trauma, such as that by Erdurman et al in Turkey who found the mean age of patients to be 26 years [40]. Warrasak S et al in Thailand found a mean age of 33.1 years [42].

Soliman et al in Egypt found the average age in ocular trauma in general to be 22 years [15].Similarly in other studies done in Kenya in regard to eye trauma, the commonest age group affected is between 20-40 years [14, 50, 51.] This finding can be attributed to the fact that young people spend more time outdoors. Young people are also likely to be involved in risky behaviour like taking alcohol, involvement in fights or working without protective wear.

After the fifth decade, the risk of injury appeared to reduce. This could be attributed to the fact that older people are less adventurous and their injuries occur in the home environment [51].

There was no significant difference in the laterality of the eye affected (Table 2) as shown by the fact that the confidence intervals overlap. Four patients had both eyes injured in the

circumstances of assault and road traffic accidents. This is in keeping with USEIR data on ocular injuries where there are more people with unilateral vision loss as compared to people with bilateral visual impairment after ocular injury[1].

6.2 Circumstances Surrounding Injury

Nearly half (46.1%) of eyes did not have the cause of injury recorded. Out of the recorded causes of injury, metallic objects were found to be the commonest cause (14.7%). Sticks accounted for 7.8% of the injuries. Glass and stone accounted for 3.9% and 2% of the injuries respectively. Other causes of injuries in our study included fist, belts and rubber bands. This compares to a similar study done by Funjika et al in Kenya who found metallic objects to be the commonest cause of eye injuries in hospitalised adults [51]. Our findings however differ from those of Kakembo et al who found sticks to be the commonest cause in ocular trauma in patients admitted to KNH eye ward. Notably however, the highest numbers of cases in that study were in age group between 0-10 years[52].

Out of the 25 eyes of children included in this study, the commonest recorded cause of injury was stick in 8 children. This compares to Murithi et al in Kenya in a review of globe injuries in children who found stick to be the commonest causative agent (40.7%) [53]. Stick injuries in children are as a result of their most common play tool in our set up.

However, a prospective study would be useful to verify the above findings as most of the causes of injury were not recorded.

In our study, circumstance of injury in most patients was unrecorded (65.7%).Out of the recorded circumstance of injury, the most common was through RTA (8.8%), followed by assault (6.9%). In Turkey most of the eye injuries involving the posterior segment were work related (26.1%) followed by assault related injuries (19.1%) [40] .In Thailand, the most common causes of injuries were industrial and automobile accident [42]. In Egypt, majority of ocular trauma was due to assault[15]. This largely shows circumstances surrounding eye injuries vary from one region to another and may be related to everyday economic activities, work environment policies, transport safety and security.

Seventy (68.60%) patients presented as self-referral to KEU while 20 (19.6%) patients were referred from other health facilities. This finding could be explained by the fact that KEU was established 41 years ago and is a well-known eye hospital in the East African region, serving clients all over Kenya as well as in surrounding countries.

Nineteen (18.6%) eyes received treatment prior to presenting to KEU as compared to 72(70.6%) which did not. This is in keeping with the fact that most patients were self-referral. The commonest treatment received prior was antibiotics and mydriatic eye drops. Five eyes had surgical intervention prior to referral with 2 eyes having had suture of sclera, 2 eyes had cataract surgery done and one eye had cornea laceration repair prior to referral. As most referred patients had already received treatment from the referral centres, this shows that the surrounding facilities are able to give basic eye care prior to referral. Some can give advanced treatment like cornea and scleral repair as well as refer appropriately. In this regard, further vision loss is averted following trauma. Strengthening these primary eye care facilities in terms of resource is vital in managing minor eye trauma and appropriate referral in major trauma cases.

6.3 Clinical characteristics of eyes

Seventy nine (74.5%) eyes had closed globe injury, while 27(25.5%) eyes had open globe injury. Studies have shown that in injuries involving the posterior segment, closed-globe injuries and sharp penetrating injuries in open globes are significant predictors of good visual outcome [42, 46].In this study however, we did not find an association of either to the final visual outcome.

Forty eight percent of all eyes had anterior segment involvement alongside posterior segment injury. However, only those with an accessible posterior segment (either by clinical examination or by ultrasound scan) were included in the study. Ocular injuries involving both anterior and posterior segment have shown to have poor outcomes particularly retinal detachment and presence of RAPD[38, 41]. There is however a paucity of studies comparing anterior segment only injuries with combined anterior and posterior segment injury outcomes. In this study, cataract was the commonest finding in anterior segment. Erdurman et al found hyphema and cataract to be the most common anterior segment pathology in 29% and 21% of the eyes with posterior segment injuries from ocular contusion that resulted to closed globe injuries[40].

Retinal detachment (46.2%) and vitreous haemorrhage (44.3%) were the most common presentations after ocular trauma. Retinal detachment also accounted for the most common cause of poor vision. There were 8(9.4%) eyes with traumatic macula hole as well as the same number of eyes with foreign body lodged in the vitreous or retina. In addition, some eyes were found to have more than one finding on examination e.g. vitreous haemorrhage and retinal detachment.

Similarly, Erdurman et al found retinal detachment to be most frequent pathology (31%) in eyes having contusion injury while vitreous haemorrhage alone occurred in 20% of eyes[40]. In open globes however, retinal detachment has been shown to be higher, occurring in approximately 40–50% of the eyes[44, 46]. However, final prognosis is similar in eyes with retinal detachment whether secondary to open or closed globe injuries[54].Retinal detachment following open globe injury is also higher than in closed globe among the paediatric age group but the outcome after intervention, like for adults is similar[55].

There were 7 eyes with endophthalmitis at presentation, comprising 26% of all eyes with open globe injury. Diagnosis was made after clinical assessment and on ocular ultrasound. Intravitreal ceftazidime and vancomycin was administered for all the cases alongside topical and systemic broad spectrum antibiotics. In the event of risk of fungal microbe, intravitreal amphotericin B was administered. All the 7 eyes with post traumatic endophthalmitis had presented with vision of PL. Only 2 had retained foreign body alongside. One eye improved to HM and one eye had NPL with rest having no improvement being at PL on final follow up.

Rate of endophthalmitis has been shown to vary from < 1% to 17%[56, 57]. In this study however, the rate of endophthalmitis may be falsely high due to a small number of eyes with open globes. In a study with a large sample size, Essex et al found a rate of 6.8% in 250 patients with open globe injuries[58]. Multiple risk factors have been reported including delay in primary repair, ruptured lens capsule, intraocular foreign body, dirty wounds and intraocular lens placement [59, 58, 60]. However, most authorities agree that the three most important risk factors for posttraumatic endophthalmitis are the presence of an intraocular foreign body, delay in closure of the globe >24 hours, location and extent of laceration and ruptured globe [56]. According to Zhang Y et al primary repair within 24 hours, intraocular tissue prolapse and self-sealing of wounds seemed to impart protective effects against the development of endophthalmitis [57].

Studies have shown a role of prophylactic antibiotics in traumatic endophthalmitis. A large prospective randomized controlled trial of 346 eyes with penetrating eye injury, the largest so far done, showed development of endophthalmitis in 0.3% (1/179) of eyes in the group receiving intracameral or intravitreal antibiotic injection as compared to 2.3% (8/167) of eyes in the control group. The conclusion was that intraocular antibiotics are effective in the prevention of acute posttraumatic bacterial endophthalmitis in eyes with retained intraocular foreign body[64].In light of the above; ccomprehensive prophylactic antibiotic treatment at the time of injury repair may improve visual acuity outcomes following open-globe injuries. Currently, the most widely accepted regimen includes a combination of topical, systemic, and intravitreal antibiotics depending on the degree of clinical suspicion of subsequent infection[56].

In spite of intervention, studies on post traumatic endophthalmitis have shown poor visual outcome with only approximately 44% of the eyes retaining vision better than 20/400[59,62].

6.4 Management of Eye Injuries

Most of the eyes, 99 (92.5%) had surgical management done. Fourteen (13.1%) and 11(10.3%) eyes had observation and medical management done respectively. Two patients were lost to follow up after initial examination.

Eleven eyes, (10.3%) had both surgical and medical management done while 8 eyes (7.5%) had observation and eventual surgical management done. All eyes that had medical intervention done were administered intravitreal antibiotics. Observation was done for eyes that presented with fresh vitreous haemorrhage or who due to the severity of injury, intervention was not done e.g. in traumatic optic neuropathy.

This finding indicates that ocular injuries involving the posterior segment require a vitreoretinal unit with adequate facilities, resources including human resource, to perform surgery as well as follow up due to the severity of these injuries.

The most common surgical procedure performed was PPV with silicon oil insertion in 39 eyes. This procedure was done for retinal detachment. Other procedures done alongside PPV included PPV with gas (perfluoropropane) for short term tamponade in retinal detachment, PPV with ILM(internal limiting membrane) peel for macula hole, and PPV with either inspection,

epiretinal membrane peel, IOFB removal (5.3%), relaxing retinotomy, nucleus removal, with laser or cryotherapy.

Pars plana vitrectomy with silicon oil insertion for tamponade is the treatment of choice in severe trauma to the posterior segment of the eye. This is because trauma related retinal detachment are complex and require prolonged tamponade and are often with proliferative vitreoretinopathy. Silicone oil used as tamponade agent in vitrectomy for penetrating injury is beneficial because it minimizes both intraoperative and postoperative haemorrhage which is a risk factor for PVR. It also maintains retinal attachment for longer and prevents hypotony [63, 64]. PVR has widely been reported as the significant cause of poor prognosis and requirement of repeat surgical procedures.

The breaks after trauma are irregular and are accompanied by other multiple pathologies making them complex retinal detachments favouring even high density silicon oil for tamponade [64].

There were 19 eyes with vitreous haemorrhage only.

Twelve eyes had scleral buckle surgery done. Out of these, 2 eyes had scleral buckle alongside PPV while 2 others had scleral buckle then later had PPV done due to 1 eye having retinal redetachment and the other having persistent subretinal fluid.

Two eyes had PRP laser done for retinal breaks but eventually had PPV done.

Fourteen eyes had traumatic cataract surgery done alongside PPV in the finding of cataract.

6.5 Outcome after Intervention

There was a statistically significant difference ($p<0.001$) in the visual acuity at presentation and at final review after various interventions. Eighty six eyes (83.5%) were blind at initial review compared to 47 eyes (45.6%) after intervention at the final follow up.

There was an improvement in eyes which had mild visual impairment from 3 eyes at presentation (2.8%) to 23 eyes (22.3%) at final follow up. Thirty nine eyes (37.9%) achieved a final visual acuity of 6/36 or better at final follow up.

The above findings show that with correct and timely intervention, good visual outcome can be achieved in eyes with trauma involving the posterior segment. Therefore every effort should be made to consult a vitreoretinal unit for timely intervention to save or sustain useful vision

especially when early presentation after injury. Since most of these injuries are in young patients, a lot of blind years are saved.

Brinton et al reported 52% of cases achieved functional success after surgical intervention in ocular trauma involving the posterior segment which compares to our results of 48.5% using the same criteria; functional success being defined as a final visual acuity of 20/100 (6/30) or better or as a postoperative improvement in visual acuity from light perception or worse to 6/240 (5/200) or better[44].

Notably, various studies have used varied definitions of functional success and therefore comparison to our findings would be largely inaccurate [38, 40,41,44,45].

Out of the 49 eyes with RD at presentation, one had no intervention done as VA was NPL at presentation and one patient was lost to follow up.

Anatomic success was defined as eyes with attached retina and generally clear media, regardless of visual function. Out of the 47 eyes which had retinal detachment at presentation, 34 eyes (72.3%) which underwent surgical intervention had attached retina at final follow up. Ersanli et al found retina attachment in 70% of the cases[43].Erdurman et al found retina attachment achieved in 81% of cases after surgery[40]. This was comparable to our study findings.

Fourteen out of 47eyes (29.8%) with RD had vision better than 6/36.Erduman et al reported 33% of eyes with RD having visual acuity of 20/100 or better.

Non attachment of retina was observed in 11(23.4%) of eyes. This was due to irreparable, recurrent or persistent retinal detachment.

Out of the 39 eyes which had PPV with silicon oil fill, 18(46.2%) eyes had subsequent silicon oil removed. 5 eyes out of 18 (27.8%) had a redetachment and 4 eyes had reinsertion of silicon oil. Our findings on the retinal redetachment rate after silicon oil removal however compare with other studies where silicon oil was used in repair of complex retinal detachments at 25.3% and 25.3%[65, 66]. This high rate has been associated mostly with PVR. PVR is significant in that it causes progressive preretinal and subretinal membrane growth with subsequent contraction resulting in traction, retinal breaks and redetachment[65].In addition, preoperative visual acuity was also reported as a risk factor to increased redetachment rates. Duration of silicon tamponade was

not related to risk of redetachment. One study has attributed low rate of redetachment to prophylactic 360 degree retinopexy during retinal detachment surgery [62].

Cataract was the most observed complication present in 11 eyes (28.2%) after silicon oil insertion.

Eyes with retinal detachment with gas used as tamponade agent showed better outcome than those treated with silicon oil with 6 (50%) eyes achieving a final VA of 6/36 or better. This was attributed to the surgeon's choice of use of gas in eyes with more peripheral breaks and detachments as opposed to use of silicon oil in extensive, more complex detachments. Only 1 eye had a redetachment after absorption of C3F8. In retinal detachments associated with PVR, PPV with intraocular tamponade using either silicon oil or C3F8 has shown no major difference in terms of outcome. The choice is of either is usually on an individual patient by patient basis[67].

Out of the 19 eyes with vitreous haemorrhage only, 15 had PPV done alongside inspection. Out of these, 12(80%) eyes subsequently had a final visual acuity better than 6/36. There was none that resolved spontaneously while on observation with follow up. This however might not be the case as 4 patients were lost to follow up in the course of management. From past studies, cases of severe traumatic vitreous haemorrhage are associated with other posterior segment pathologies and therefore the visual outcomes are guarded [46]. In these combined injuries, vitreous haemorrhage is a strong predictor of PVR especially in cases with full thickness scleral penetrations.

Eight eyes had macula hole surgery with PPV, ILM peeling with inverted flap technique and 6 of the eyes (75%) had macula hole closure at final follow up. Amari et al found closure of macular hole was achieved in 16 (70%) eyes with one surgery and in 22 (96%) of the 23 eyes with two surgeries [47]. None of our patients had more than one surgical intervention. In comparison to similar technique of inverted internal limiting membrane in the management of large traumatic macular holes, 100% closure rate was achieved and it was reported as a good adjuvant to standard vitrectomy[48].

Eight eyes had foreign body in the posterior segment. 6 were metallic, 1 was a piece of stick and 1 was glass. 4 eyes had final vision better than 6/18 in Snellen's chart. Two eyes had associated RD with PVR, while 2 others had associated endophthalmitis. Good anatomical outcome in eyes

with posterior segment IOFB can be achieved. Predictive factors for anatomical failure have been identified including; delay in IOFB extraction, presence of intraocular haemorrhage, preoperative retinal detachment, and primary surgical repair combined with IOFB removal[68]. Valmaggia et al in Germany reported good outcome in ocular injuries with a metallic intraocular foreign body in the posterior segment as a result of hammering unless where the macula was involved [69]. The mean final BCVA was 20/39 with 82.8% of eyes having the final BCVA as 20/40 or more. These are promising results as 75% of the eyes in our study with IOFB were metallic. Therefore with good vitreoretinal set up as well as timely intervention, eyes with IOFB are capable of retaining normal vision or suffering only mild visual impairment.

Overall, complications after surgery included cataract which was most common. Two eyes had eventual phthisis while 2 others developed glaucoma.

Causes of poor outcome included macula scar in 8 eyes (7.5%), PVR and traumatic optic neuropathy in 5 (4.7%) eyes each, and retina membranes in 2 eyes (1.9%). There was no case of post-surgical endophthalmitis.Similarly; Erdurman et al found PVR, macular scarring and optic nerve damage as having prognostic significance eyes with posterior segment injuries [40].

The median follow up time was, 5 months (0-45 months).Drop out from follow up increased with increase in duration post intervention. The highest post intervention loss to follow up was noted in eyes with blindness at final assessment, with only 11 patients on follow up at 6 months post intervention. This could be attributed to the patients feeling that there was no need to come for review as they were spending a lot of money yet still the eye was not having good vision.

Sixty seven eyes (67.7%) had one surgical intervention performed. Twenty two (22.2%) eyes and 8(8.0%) eyes had 2 and 3 subsequent surgical interventions respectively.1 eye had 4 procedures performed and 1 other eye had up to a 5th procedure performed. These included subsequent PPV, silicon oil removal, cataract surgery or posterior capsulotomy.

Out of the studied associations of final visual outcome, a statistically significant difference was observed only in the number of interventions with the final visual outcome (p= 0.049). Eyes which had more number of surgical interventions done had a higher chance of worse visual outcome (Table 9). This could have probably due to more structural damage from the trauma necessitating more surgery.

There was no statistically significant difference observed between duration of injury to presentation, duration of follow up, status of the globe, whether closed or open with the final visual outcome.

Previous vitrectomy in particular has been reported to be associated with retinal redetachment requiring a subsequent procedure .Number of previous surgeries was associated with lower anatomical success rate as seen by Lam et al in a study of eyes with retinal detachment with PVR treated with silicon oil tamponade with subsequent silicon oil removal (P=0.010) [70].In this study however, there was insufficient records to study these factors and therefore a prospective study would be of benefit to study these associations in our set up. Previous studies have shown other factors associated with visual outcome including post traumatic endophthalmitis, PVR and RAPD[38, 41].

Only 48 patients had an OTS score details that could be retrieved from the file (Table 10). For the category of OTS score of 3 and 4, the findings were comparable to the OTS score developed by United States Eye Injury Registry (USEIR).This was more so for the eyes that had final visual acuity of between PL to <6/12 . For OTS score of 1 and 4, there were 2 and 3 eyes respectively from this study and therefore adequate conclusions could not be made in comparison to the standard OTS Score. There was no eye with an OTS score of 5.

In comparison ,a study from South Africa analysing the relevance of the OTS in open globe injuries, it was found that patient outcomes were significantly worse in category 2, but when the entire distribution was tested, the differences were not statistically significant[71]. The authors concluded that OTS may also be a valid predictor of outcome in an African setting. Closed globe injuries however were not included. Larger sample size is required to accurately conclude that OTS score can be used in our set up to predict outcome of posterior segment involvement in eye injuries including both open and closed globe injuries. This would preferably be in a prospective study.

Study Limitations

1. Patients lost to follow up did not have BCVA therefore the overall final visual outcome may have been better
2. The whole eyeball is usually injured in ocular trauma and therefore visual outcome may not entirely be due to posterior segment injuries only.
3. Some records for patients seen in the 5 year period covered by the study were unavailable and therefore not all cases were captured and assessed.

CONCLUSION

1. There was a male preponderance to ocular injuries involving the posterior segment
2. The commonest circumstances surrounding posterior segment injuries were not known. Out of the known ones, RTA and physical assault were the most common.
3. Various interventions were vision saving in eyes with ocular injuries involving posterior segment
4. Eyes that had fewer surgical interventions had higher likelihood of good vision outcome

RECOMMENDATIONS

1. Improve the recording of all relevant patient information at initial and follow up visits. We recommend world eye injury registry initial report form and 6 month follow up form for recording and for follow up at 6 months (Appendix 1 and 2).This has been developed by USEIR
2. Vitreoretinal services should be made available at least in every level 5 hospital with equipped eye units and trained surgeons and nurses
3. Timely Intervention should be done in eyes with posterior segment injuries or referral to a vitreoretinal unit as this is vision saving

CASE REPORTS

Case 1

A 23 year old female patient was referred to KEU from a peripheral clinic. She had been assaulted by robbers and a piece of glass from broken spectacles had injured her right eye 5 hours prior to being seen at KEU. She reported sudden onset of pain and loss of vision in the right eye. There were no complaints related to the left eye. She had been putting on glasses but we could not ascertain her refractive correction prior. She otherwise did not have any other prior incident of ocular trauma, no ocular surgery, nor contact lens wear. Past medical history was unremarkable, and she was not on any systemic medication. Family history was non-contributory. She was a student at a university in Nairobi.

On initial examination, she was in acute ocular distress. Her right eye vision was hand motion. Left eye vision using the Snellen visual acuity chart at 6 metres was 6/9. The right eye had bruising, subconjunctival haemorrhage, conjunctival chemosis, and an irregular linear corneal laceration extending from twelve to seven o'clock involving the limbus at seven o'clock with iris prolapsing through the wound. The right eye anterior chamber was shallow. The pupil was irregular but responding to light. Visualisation of further details was obscured. Examination of the anterior and posterior segments of the left eye was normal without signs of trauma.

The right eye was protected with an eye shield and the patient was given paracetamol, tetanus prophylaxis and prepared for surgery.

The patient was taken to theatre and examination under anaesthesia as well as corneoscleral wound repair was done on the same day. Scleral extension to the corneal wound at 7 o'clock was noted for 3 millimetres length. Ten interrupted 10-0 nylon sutures were placed to reapproximate the corneal wound. She was then reviewed at first operative day and discharged on eye medications which included frequent administration of topical prednisolone acetate 1% to control inflammation and prophylactic antibiotic coverage with ofloxacin eye drops.

Review after seven days showed a formed globe, the cornea was clearing and retina was attached.

One month after cornea repair, right eye vision was hand motion. A rhegmatogenous bullous inferior RD was noted on dilated fundoscopy.

The patient was scheduled for a PPV, cryotherapy and silicon oil fill. Superior peripheral retinal break was noted and cryotherapy was done to the break. On first post-operative day, subretinal fluid was noted in the inferior peripheral retina.

Two weeks after the second surgery, vision was hand motion and the retina was now attached. In subsequent visits, vision remained at hand motion and retina attached with optic disc and macula normal. Right eye cataract was noted. Cornea stitches were also removed.

Seven months after the retinal detachment surgery, the patient's right eye had penetrating keratopalsty (PKP) done, lens washout, scleral fixated lens put and silicon oil removal done.

Two months after PKP, the corneal graft was intact. BCVA was 6/60 and the scleral fixated lens was centred. The patient was put on frequent steroid eye drops on the right eye.

On her last visit seven months after PKP and scleral fixated intraocular lens, the patient was fitted contact lens on her right eye and BCVA was 6/36. There had been no episode of cornea graft rejection.

Case 2

A 33 year old male patient was referred to KEU from a tertiary care hospital for further management.

The patient had sustained injury to his left eye when he was hammering a metal in his work place 17 days prior. He was a jua kali artisan and was not using protective eye glasses at the time. He reported left eye immediate impaired vision which had progressively become worse, as well as pain.

He initially went to a tertiary hospital 14 days after the injury where a B scan ocular ultrasound was done and showed an intraocular foreign body in the vitreous with peripheral vitreous detachment.

He was not using any ocular medication at the time. Past medical history was unremarkable, and he was not on any systemic medication.

On initial examination at KEU, the right eye corrected vision on Snellen visual acuity chart at 6 metres was 6/6. Left eye vision was hand motion. Right eye examination was essentially normal.

Left eyelids were normal. The conjunctiva was injected especially superiorly suggesting a previous laceration. The cornea was hazy but no visible scar. The anterior chamber was deep with few red blood cells. There was posterior synechiae at 10 to 11 o'clock position. The lens had an early cataract. On dilated fundoscopy the posterior pole was not visible due to vitreous haemorrhage which was extending inferiorly. The superior retina was attached.

Left eye ocular ultrasound scan done at KEU showed inferior peripheral vitreous detachment with an IOFB in the inferior quadrant which was hyperechoic and persisting on reduced gain. The retina was attached in all quadrants. The patient was put on left eye atropine eye drops 1% 12 hourly. He was counselled for left eye surgery including lens washout with or without intraocular lens, PPV, IOFB removal and silicon oil fill. The patient was prepared for surgery (including informed consent) which was done 6 days later under local anaesthesia.

Intraoperatively, left eye lens washout was done and PPV. On examination under anaesthesia, there was a metallic IOFB at 5 o'clock in the mid periphery and a superior RD.

IOFB was removed (metal fragment, 2.5 mm size); fluid gas exchange was done as well as endolaser at the site of the IOFB. Silicon oil fill was done and the retina was noted attached. The patient was left aphakic.

On first post-operative day, the patient's left eye had a clear cornea. There was good silicon oil fill and retina was attached in all quadrants. The patient was discharged on topical steroid - antibiotic 6 hourly as well as timolol eye drops 12 hourly.

At one week operative, there was good silicon oil fill and the retina remained attached. There was a thin posterior capsular opacity which became dense as the patient came for subsequent follow up a month later.

At 3 months post-operative period, BCVA was 6/36. The retina remained attached and the intraocular pressure was normal. Silicon oil removal and secondary posterior chamber IOL insertion was done at 4 months post-operative period. There was post-operative cornea haziness which resolved after one week while the patient was put on a frequent steroid antibiotic eye drop. YAG laser capsulotomy was done one week later and the best corrected vision acuity on spectacles improved 2 weeks later to 6/12. Spectacles were prescribed then.

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Appendix 1:

WORLD EYE INJURY REGISTRY

INITIAL REPORT

1) Check appropriate responses 2) Fill out comments 3) File bilateral injury reports seperately
4) Submit Data via WEIRONLINE.org 5) Write Down Record ID _____

A IDENTIFICATION:

Patient's Initials: _____
Patient's Home ZIP: _____
Medical Rec. #_____
Age: _____ Sex: ☐ M ☐ F
Injury Date: _____/_____/_____
Eye: ☐ Right ☐ Left
Race:_____
Initial Rx MD: _____
Initially Treated At:_____
Reporting MD: _____
Exam Date for Report:
_____/_____/_____
Report Filer's Name: _____
_____
Contact for 6 mo F/U: _____
_____

M BILATERAL INJURY: ☐ Yes ☐ No

B EYE PROTECTION:

☐ Yes ☐ No ☐ Unknown
☐ Regular ☐ Safety ☐ Sun
Glass Shattered? ☐ Yes ☐ No ☐ Unknown

C PATIENT A BYSTANDER:

☐ Yes ☐ No ☐ Unknown

D WORK-RELATED:

☐ Yes ▸ *List Occupation below*
☐ No ☐ Unknown
Occupation: _____

E PLACE:

☐ 01 Industrial Premises
☐ 05 Farm
☐ 10 Home
☐ 20 School
☐ 30 Place for Recreation & Sport*
☐ 40 Street and Highway*
☐ 60 Public Building*
☐ 98 Unknown
☐ 99 Other*
*Specify: _____

F INJURY'S ZIP: _____

G INTENT: ☐ 52 Unintentional
☐ 50 Assault ☐ 98 Unknown
☐ 51 Self-inflicted (intentional)

H DRUG USE: ☐ Y ☐ N ☐ Unknown
*Describe:*_____
ALCOHOL USE: ☐ Yes ☐ No ☐ Unknown

I SOURCE:

☐ 00 Hammer on Metal
☐ 10 Sharp Object*
☐ 11 Nail
☐ 25 Fall
☐ 20 Blunt Object*
☐ 30 Gunshot
☐ 31 BB/Pellet Gun
☐ 40 Motor Vehicle Crash
☐ 50 Fireworks*
☐ 60 Burn
☐ 70 Explosion
☐ 90 Lawn Equipment*
☐ 98 Unknown
☐ 99 Other*
**Description of Source:* _____
_____

J TISSUES INVOLVED:

☐ 00 Lids
☐ 09 Lacrimal System
☐ 10 Cornea
☐ 19 Sclera
☐ 20 Iris
☐ 22 Anterior Chamber
☐ 30 Lens
☐ 40 Vitreous
☐ 50 Retina
☐ 55 Macula
☐ 58 Choroid
☐ 60 Extraocular Muscle
☐ 70 Orbit
☐ 80 Optic Nerve
☐ 99 Other*
**Describe:* _____
_____

K VISION (OF BOTH EYES):

DATE:_____/_____/_____

RE		LE
☐ 00	NLP	☐ 00
☐ 10	LP	☐ 10
☐ 20	HM	☐ 20
☐ 30	1/200 to 4/200 (CF)	☐ 30
☐ 40	5/200 to 19/200	☐ 40

____ If > 19/200 Specify Accuity ____

☐ 91 --- Not Tested --- ☐ 91
☐ 98 --- Unknown --- ☐ 98
☐ 99 --- Other --- ☐ 99

M EYE NORMAL PRIOR TO INJURY?

☐ Yes ☐ Unknown
☐ No *(Explain)* _____
_____

L COMMENTS: *(Please describe the injury as much as possible):*

_____
_____
_____
_____

Rev. 10/3/2000 _____

M INITIAL DIAGNOSES:

OPEN GLOBE INJURY: ☐ Yes ▸ ☐ 18.5 Postequatorial Extension ☐ No
LACERATION: ☐ 00.0 Perioc. ☐ 02.0 Lacrim. ☐ 08.1 Contusion
PARTIAL THICKNESS WOUND: ☐ 09.1 Corneal ☐ 09.2 Scleral
CORNEAL BURN: ☐ 12.0 Thermal ☐ 12.1 Alkal. ☐ 12.2 Acid
RUPTURE: ☐ 10.3 Corneal _____ mm ☐ 18.3 Scleral _____ mm
☐ 13.3 Corneoscleral _____ mm
PENETRATING INJURY:
☐ 10.4 Corneal _____mm ☐ 18.4 Scleral _____mm ☐ 13.4 Corneoscleral _____mm
IOFB: ☐ 90.0 Magnetic ☐ 90.1 Ant. Segment ☐ 90.2 Post. Segment
☐ 91.0 Nonmagnetic ☐ 91.1 Ant. Segment ☐ 91.2 Post. Segment
PERFORATING INJURY: ☐ 18.2 Perforating Injury ☐ 18.21 Corneoscleral
☐ 18.22 Scleroscleral
UVEA IN WOUND: ☐ 18.1 Scleral ☐ 10.1 Cornea ☐ 11.1 In Visual Axis
WOUND DEHISCENCE: ☐ 19.0 **HYPHEMA:** ☐ 20.0 _____%
IRIS PUPIL: ☐ 22.0 Iris Laceration/Dialysis ☐ 22.3 Afferent Pupil Defect
IOP: ☐ 24.0 Angle Recession ☐ 26.0 Glaucoma, Secondary ☐ 28.0 Hypotony
LENS: ☐ 30.0 Cataract (Traumatic) ☐ 32.0 Subluxed Lens ☐ 32.1 Dislocated Lens
VITREOUS: ☐ 40.0 Hemorrhage ☐ 42.0 Penetration
RETINA: ☐ 50.0 Retinal Hemorrhage ☐ 55.5 Macular Hemorrhage
☐ 51.0 Retinal Edema ☐ 55.2 Macular Edema ☐ 52.0 Retinal Defect
☐ 52.1 Tear ☐ 52.2 Giant Tear ☐ 52.3 Laceration ☐ 52.4 Dialysis
☐ 53.0 Retinal Detachment ▸ *Number of Quadrants?* ☐ 1 ☐ 2 ☐ 3 ☐ 4
RD TYPE: ☐ 53.1 Hemorrhagic ☐ 53.2 Tract. ☐ 53.3 Rhegm. ☐ 53.5 Macular
CHOROID: ☐ 58.0 Hemorrhage ☐ 58.1 Rupture
OPTIC NERVE INJURY: ☐ 82.0 Optic Nerve
ORBITAL: ☐ 70.0 Fracture ☐ 71.0 Foreign Body ☐ 73.0 Hemorrhage
INFLAMMATION: ☐ 95.0 Uveitis ☐ 92.0 Endophthalmitis ▸ *Organism:*_____
☐ 99.0 Other or comments: _____
_____

N INITIAL OPERATION: Date: _____/_____/_____

REPAIR EYELID WOUND: ☐ 00.0 Full-thickness ☐ 00.1 Partial-thickness
REPAIR LACRIMAL: ☐ 02.0 **GLOBE:** ☐ 18.0 Exploration of Globe
REPAIR CORNEAL: ☐ 10.4 Laceration ☐ 10.3 Rupture
REPAIR SCLERAL: ☐ 18.4 Laceration ☐ 18.3 Rupture
REPAIR CORNEOSCLERAL: ☐ 13.4 Laceration ☐ 13.3 Rupture
IOFB: ☐ 90.1 IOFB Removal by Magnet from Anterior Segment
☐ 90.2 IOFB Removal by Magnet from Posterior Segment
☐ 91.1 IOFB Removal by Forceps from Anterior Segment
☐ 91.2 IOFB Removal by Forceps from Posterior Segment
CORNEA: ☐ 19.2 Corneal Transplant ☐ 19.3 Temporary Keratoprosthesis (TKP)
REPAIR WOUND DEHIS: ☐ 19.0 Dehiscence **HYPHEMA:** ☐ 20.0 Removal
IRIS: ☐ 22.0 Iridectomy ☐ 22.1 Iridoplasty ☐ 22.2 Iridotomy
LENS: ☐ 30.0 ECCE ☐ 30.2 Phaco ☐ 30.3 Pars Plana Lensectomy
IOL: ☐ 36.1 AC ☐ 36.2 PC
VITRECTOMY MECHANICAL: ☐ 44.0 Anterior ☐ 44.1 Posterior
VITRECTOMY OPEN-SKY: ☐ 44.2
ANTIBIOTICS: ☐ 45.0 Intravitreal ☐ 45.1 Intracameral
RD PROPHYLAXIS: ☐ 53.0 Cryopexy ☐ 53.1 Laser ☐ 53.2 Buckle
RD REPAIR: ☐ 53.01 Cryopexy ☐ 53.11 Laser ☐ 53.5 Buckle ☐ 53.3 Vitrectomy
☐ 53.7 Air ☐ 53.4 Gas ☐ 53.6 Silicone Oil ☐ 53.8 Pneumatic Retinopexy
REPAIR EXTRAOCULAR MUSCLE: ☐ 60.0
ORBIT: ☐ 70.0 Fract. Repair ☐ 71.0 FB Removal ☐ 75.0 Decomp.
☐ 93.0 Evisceration ☐ 94.0 Enucleation ☐ 97.0 None ☐ 98.0 Unknown
OTHER: ☐ 99.0 Other or Comments:_____
_____

Appendix 2:

WORLD EYE INJURY REGISTRY

6 MONTH FOLLOW-UP REPORT

1) Check appropriate responses **2)** Fill out comments **3)** File bilateral injury reports seperately
4) Submit Data via WEIRONLINE.org **5)** Write Down Record ID _____

A IDENTIFICATION:
Patient's Initials: _____
Patient's Home ZIP: _____
Medical Rec. #_____
Age: _____ Sex: ☐ M ☐ F
Injury Date: _____/_____/_____
Eye: ☐ Right ☐ Left
Race:_____
Reporting MD: _____
Exam Date for Report:
_____/_____/_____
Report Filer's Name: _____
_____

O CORRECTED VISION:
DATE:_____/_____/_____
☐ 00 NLP
☐ 10 LP
☐ 20 HM
☐ 30 1/200 to 4/200 (CF)
☐ 40 5/200 to 19/200
Specify VA _____
☐ 91 Not Tested
☐ 98 Unknown
☐ 99 Other _____
Description of follow up vision test:
_____
_____

P LENS STATUS:
☐ 10 Phakic - Clear
☐ 20 Phakic - Cataract
☐ 30 Phakic - Unknown
☐ 40 Aphakic - Clear
☐ 50 Aphakic - Membrane
☐ 60 Aphakic - Unknown
☐ 71 Pseudophakic - AC
☐ 80 Pseudophakic - PC

U HOSPITALIZATION DUE TO INJURY?
☐ Yes ☐ No ☐ Unknown

Q VISUAL FIELD:
☐ 10 100%
☐ 20 75%
☐ 30 50%
☐ 40 25%
☐ 50 < 25%
☐ 60 0%
☐ 98 Unknown

S VISUAL LOSS CONTR. FACTORS:
☐ 01 Eyelid
☐ 10 Cornea
☐ 21 Glaucoma
☐ 22 Pupillary Opacity
☐ 30 Cataract
☐ 40 Vitreous Opacity
☐ 50 Retina
☐ 55 Macula
☐ 58 Choroid
☐ 70 Orbit
☐ 80 Optic Nerve
☐ 97 None
☐ 98 Unknown
☐ 99 Other_____

R VISUAL FUNCTION:
☐ 10 Stable
☐ 20 Improving
☐ 30 Decreasing
☐ 98 Unknown

RR POTENTIALLY IMPROVABLE WITH ADDITIONAL TREATMENT?
☐ Yes ☐ No ☐ Unknown

T REHAB. STATUS:
☐ 10 Former Job_____
☐ 20 Limited Job _____
☐ 30 Unemployed
☐ 40 Retraining
☐ 50 Student
☐ 51 Child
☐ 98 Unknown
☐ 99 Other _____

V COMMENTS:_____
_____
_____
_____

W LATE DIAGNOSES:
LID: ☐ 01.0 Eyelid Deformity
☐ 03.0 Lacrimal Obstruction
☐ 04.0 Conjunctival Scarring
CORNEA: ☐ 10.5 Corneal Scar
▸ *In Visual Axis?* ☐ 14.1 Y ☐ 14.2 N
☐ 10.6 Corneal Edema
▸ *In Visual Axis?* ☐ 14.1 Y ☐ 14.2 N
IRIS: ☐ 22.1 Iris Deformity
☐ 22.2 Pupillary Membrane
☐ 24.0 Angle Recession
☐ 26.0 Glaucoma, Secondary
▸ *Controlled?* ☐ 26.1 Yes ☐ 26.2 No
LENS: ☐ 28.0 Hypotony
☐ 28.1 Phthisis
☐ 30.0 Cataract, Traumatic
☐ 32.0 Subluxed
▸ ☐ 32.1 Dislocated Lens
☐ 34.0 Aphakia
☐ 36.0 Pseudophakia
▸ ☐ 36.1 AC IOL ☐ 36.2 PC IOL
HEMORRHAGE: ☐ 40.0 Vitreous
☐ 50.0 Retinal ☐ 55.5 Macular
EDEMA: ☐ 51.0 Retinal Traumatic
☐ 55.2 Macular
DEFECT: ☐ 52.0 Retinal ☐ 52.1 Tear
☐ 52.2 Giant Tear ☐ 52.3 Laceration
☐ 52.4 Dialysis ☐ 52.5 Hole
☐ 53.0 Retinal Detachment
▸ *Number of Quadrants?*
☐ 1 ☐ 2 ☐ 3 ☐ 4
☐ 53.1 Hemorrhagic ☐ 53 .2 Tractional
☐ 53.3 Rhegmatogenous
☐ 53.5 Macular
☐ 57.0 Proliferative Vitreoretinopathy
▸ *PVR Stage* ☐A ☐B ☐C ☐D
☐1 ☐2 ☐3
☐ 55.0 Macular Degeneration/Scarring
☐ 55.1 Epimacular Membrane
☐ 55.3 Macular Hole
CONTUSION: ☐ 55.4 Maculopathy
☐ 54.0 Retinopathy

W LATE DIAGNOSES (CONT.):
CHOROIDAL: ☐ 58.0 Hemorrhage ☐ 58.1 Rupture
☐ 64.0 Strabismus
OPTIC NERVE: ☐ 88.0 Atrophy ☐ 82.0 Injury
☐ 92.0 Endophthalmitis Organism _____
☐ 95.0 Uveitis ☐ 93.0 Sympathetic ophthalmia
☐ 96.0 Enophthalmos ☐ 97.0 Proptosis
☐ 98.0 Unknown
☐ 99.0 Other or Comments *(use space below)*
_____
_____
_____
_____

X ADDITIONAL OPERATIONS:

	DATE #2 ____/____/____ #2	DATE #3 ____/____/____ #3	DATE #4 ____/____/____ #4	
REPAIR EYELID WOUND	☐	☐	☐	00.3 Oculoplastic Surgery, Eyelids
LACRIMAL	☐	☐	☐	02.0 Repair Lacrimal System
	☐	☐	☐	18.0 Exploration of Globe
IOFB EXTR., MAGNET	☐	☐	☐	90.1 Anterior Segment
	☐	☐	☐	90.2 Posterior Segment
IOFB EXTR., FORCEPS	☐	☐	☐	91.1 Anterior Segment
	☐	☐	☐	91.2 Posterior Segment
LENS	☐	☐	☐	30.0 ECCE
	☐	☐	☐	30.2 Phaco
	☐	☐	☐	30.3 P.P. Lensectomy
IOL	☐	☐	☐	36.1 AC IOL
	☐	☐	☐	36.2 PC IOL
VITRECTOMY	☐	☐	☐	44.0 Vitrectomy, Open Sky
	☐	☐	☐	44.1 Vitrectomy, Total Pars Plana
WOUND DEHIS	☐	☐	☐	19.0 Repair
CORNEA	☐	☐	☐	19.2 Transplant
	☐	☐	☐	19.3 Temporary Keratoprosthesis (TKP)
IRIS	☐	☐	☐	22.0 Iridectomy
	☐	☐	☐	22.2 Iridotomy
	☐	☐	☐	22.1 Iridoplasty
IOP	☐	☐	☐	26.0 Glaucoma Procedure
ANTIBIOTICS	☐	☐	☐	45.0 Vitreous
	☐	☐	☐	45.1 AC
RD PROPHYLAXIS	☐	☐	☐	53.0 Cryopexy
	☐	☐	☐	53.1 Laser
	☐	☐	☐	53.2 Buckle
RD REPAIR	☐	☐	☐	53.01 Cryopexy
	☐	☐	☐	53.11 Laser
	☐	☐	☐	53.5 Buckle
	☐	☐	☐	53.3 Vitrectomy
	☐	☐	☐	53.4 Gas
	☐	☐	☐	53.7 Air
	☐	☐	☐	53.6 Silicone Oil
	☐	☐	☐	53.8 Pneumatic Retinopexy
EXTRAOCULAR MUSCLE	☐	☐	☐	60.0 Repair
ORBIT	☐	☐	☐	70.0 Fracture Repair
	☐	☐	☐	71.0 F.B. Removal
ENVIS/ENUC	☐	☐	☐	93.0 Evisceration
	☐	☐	☐	94.0 Enucleation
ENOPHTHALMOS REPAIR	☐	☐	☐	96.0 Enopthalmos Repair
MISC.	☐	☐	☐	97.0 None
	☐	☐	☐	98.0 Unknown
	☐	☐	☐	99.0 Other or Comments *(use space below)*

_____
_____
_____
_____

Rev. 10/3/2000

Appendix 3:

DATA COLLECTION TOOL

PATTERN AND OUTCOME OF POSTERIOR SEGMENT INJURIES AFTER OCULAR TRAUMA AT THE VITREORETINAL UNIT IN KIKUYU EYE HOSPITAL

(*0 and 1 is the code applicable for a No/Yes response respectively. For listed items, the code is derived from the number of the item*.)

1. IDENTITY

Initials …….

Patient's Code……..

Age (in years)……

Sex……Male=1, Female= 2 ☐

County of residence…….

2. HISTORY

Eye injured……RE=1, LE=2 ☐

Days between injury and first health facility ☐

Days between injury and assessment at KEU ☐

Cause of injury

1. Nail
2. Glass
3. Stone
4. Metal
5. Physical assault
6. Unknown
7. Other (*Specify*)……..

3. Nature of injury environment
    1. Workplace
    2. Assault
    3. Road Traffic Accident
    4. Home accident
    5. Explosive devices
    6. Recreation areas
    7. Other place (*Specify*)……..
    8. Unknown

4. Treatment before hospitalization

    No/Yes ☐

    If Yes specify…….

    Referred? No/Yes..... ☐

    Intervention at referring facility…….

5. Any systemic comorbidity? (*YES/NO.*) *(Specify*)…… ☐

6. Ocular findings at initial examination or preoperative findings
    1. BCVA (Snellen chart) of injured eye……
    2. Relative afferent pupillary defect (*Yes/No*) …….
    3. Open Globe (*Yes/No*) ……..…
    4. Closed globe (*Yes/No*)…….
    5. Endophthalmitis (*Yes/No*)……
    6. OTS Score for injured eye……

7. Anterior segment structures involvement (*Yes/No*) *(Specify)*

Eyelids…….

Conjunctiva…….

Sclera……

Cornea……

Anterior Chamber……

Iris……

Lens……

8. Posterior segment access……

Yes=1, No=2

9. Clinical findings in posterior segment (Including intraoperative findings)

Vitreous……..

Choroid……..

Retina……

Macula…….

Optic nerve……

Foreign Body……*Specify Type*……

10. Investigation findings of posterior segment (Ultrasonography/ Optical Coherence Tomography (OCT)/Computed Tomography). *Yes/No* ☐

Vitreous……..

Choroid……

Retina……

Macula…….

Optic nerve……

Intraocular foreign body……

11. Interventions done…….

1= Observation

2=Medical management…….

3= Surgical management. *Specify*……

12. Number of surgical interventions done…….

13. Post-operative Follow Up

TIME	Snellen's BCVA	Fundoscopy Findings	Complication
Post op day 1(POD 1)			
WEEK 1			
MONTH 1			
MONTH 3			
MONTH 6			
FINAL FOLLOW UP (Indicate Time postintervention)			

Appendix 4

MMed Dissertation Budget

Study Title: Pattern and Outcome of Posterior Segment Injuries after Ocular Trauma at the Vitreoretinal Unit in Kikuyu Eye Hospital

Study Area: P.C.E.A Kikuyu Hospital Eye Unit

ITEM	**Quantity**	**Unit cost**	**Total cost**
Proposal preparation			
Proposal Printing (7 copies)	189 pages	10	1890
Binding Proposal	7 copies	100	700
Ethics	1 copy	2000	2000
Internet cost per month	7 months	2400	16800
Transport services for permission to Kikuyu Eye Unit			2000
Subtotal			**23390**
Data Tools/collection			
Typing &Printing of Questionnaires(7 Copies)	6 pages each	60 per page	2520
Photocopy of Questionnaires (200 questionnaires)	6 pages each	3	3600
Telephone costs per minute	1000 minutes	3 per minute	3000
Stationery – others e.g. papers, pens, erasers			2000
Flash disc 8GB	1	1000	1000
Box files for filing questionnaires	3	450	1350
Subtotal			**15270**
Transport to Kikuyu Eye Unit 25 days	**25**	**400 per day**	**10000**
Contracted Services			
Statistician/ Data entry clerk	1	50000	50000
Research assistants for 20 days	2 people	800 per day	32000
Transport costs for result dissemination	3 days	400 per day	1200
Subtotal			**83200**
Printing Costs and Binding of Temporary book			
Typing and printing of results (Black & White) 3 copies	3*Approximately 80 pages	20	4800
Printing of results (Colour) 3copies	3 * approximately 15pages	30	1350
Spiral bound book-temporary 3 copies	3	100	300
Printing & binding of Final books-8 copies			
Printing (Black & White)	80pages	10	800
Photocopy B&W	80x8	3	1920
Printing of Coloured pages	15pages x9	30	4050
Binding books Black cover	9 copies	300	1800
Subtotal			**15020**
TOTAL			**Ksh 146,880**

Appendix 5

P.C.E.A Kikuyu Hospital

P.O. Box 45-00902 Kikuyu, Tel: (020) 2044766-68, (020) 2044769-71
Fax: (020)2044765/772 Mobile:0722-207636 / 0733-606133 / 0736-270192

4th May 2015

Dr. Grace Nguyo
UON Department of Ophthalmology
NAIROBI

Dear Madam,

RE: PATTERN AND VISUAL OUTCOME OF POSTERIOR SEGMENT TRAUMA

Thank you for choosing KEU to conduct a study on the above subject.

We would like to inform you that the request has been approved. You will carry out the study under the supervision of Dr. Jafferji.

At the end of the study you are required to furnish the hospital with copy of the research findings.

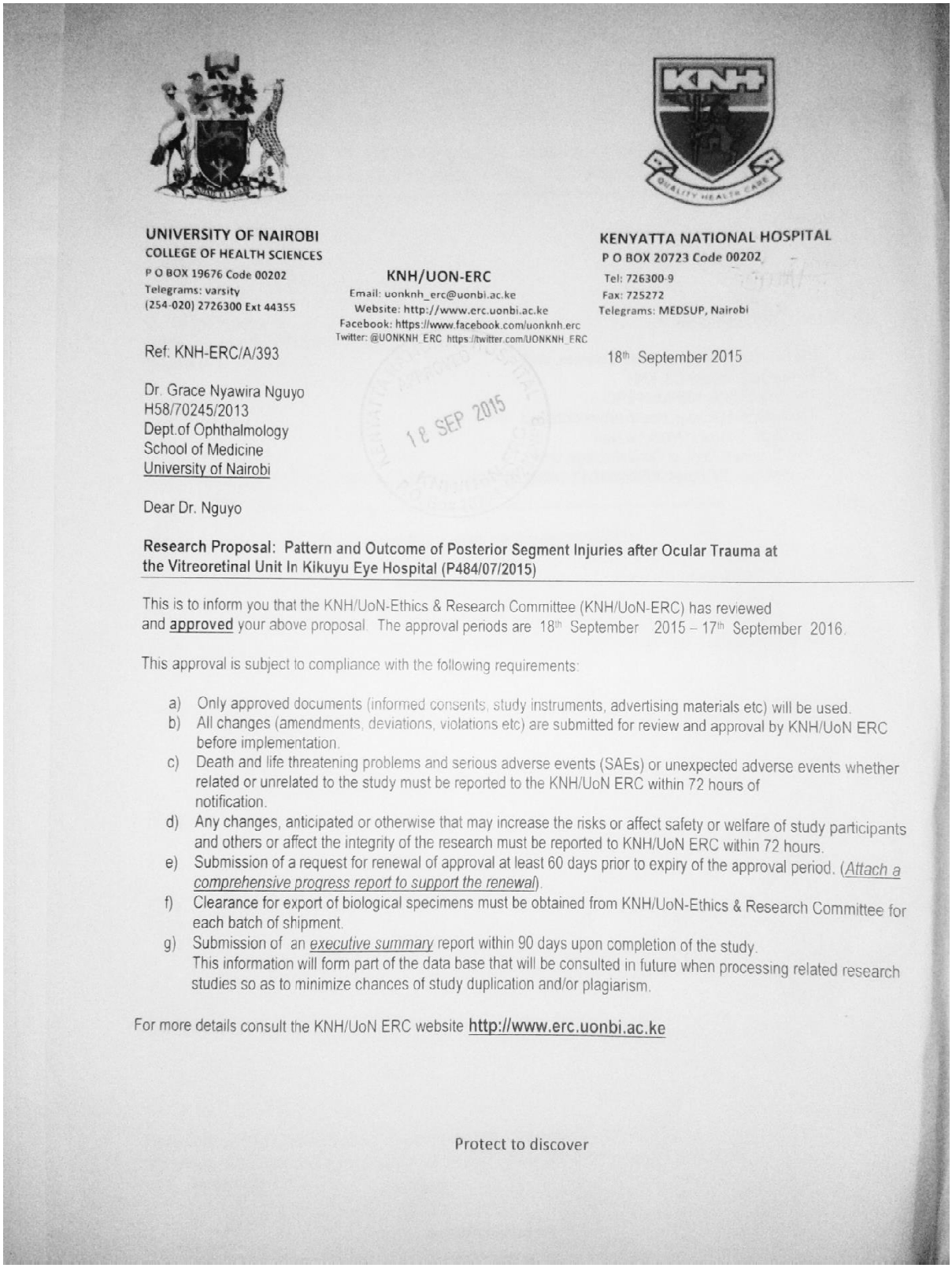
Yours faithfully,

Dr. Alain N. Mbongo-Zindamoyen
Director of Clinical Services (Eye Unit)

Cc

CEO
Dr. Jafferji

Appendix 6



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Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/393

18th September 2015

Dr. Grace Nyawira Nguyo
H58/70245/2013
Dept.of Ophthalmology
School of Medicine
University of Nairobi

18 SEP 2015

Dear Dr. Nguyo

Research Proposal: Pattern and Outcome of Posterior Segment Injuries after Ocular Trauma at the Vitreoretinal Unit In Kikuyu Eye Hospital (P484/07/2015)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 18th September 2015 – 17th September 2016.

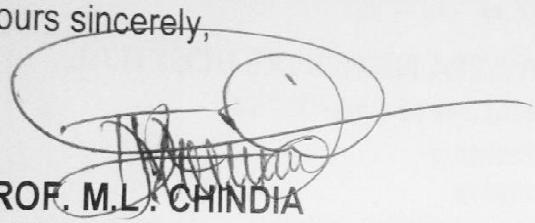
This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **http://www.erc.uonbi.ac.ke**

Protect to discover

Yours sincerely,



PROF. M.L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS, KNH
The Chairperson, KNH/UoN-ERC
The Assistant Director, Health Information Dept. KNH
The Dean, School of Medicine,UoN
The Chairman, Dept. of Ophthalmology, UoN
Supervisors: Dr. Njuguna Margaret, Dr.Jafferji Shaffiq