A REVIEW OF ANTERIOR SEGMENT INJURIES AT KIKUYU EYE UNIT IN KENYA, A 3-YEAR RETROSPECTIVE STUDY

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF NAIROBI DEPARTMENT OF OPHTHALMOLOGY IN PARTIAL FULFILMENT FOR THE AWARD OF DEGREE OF MASTER OF MEDICINE IN OPHTHALMOLOGY - M.MED (OPHTH)

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H58/11143/2018

DECLARATION

This dissertation is my original work, and has not been submitted for a degree at any other University.

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THIS DISSERTATION HAS BEEN SUBMITTED WITH OUR APPROVAL AS SUPERVISORS.

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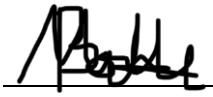
Signed 

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Date 24th May 2023

DEDICATION

I dedicate this work to the memory of my late father, Joseph Chege, for his unwavering support, sacrifices and love towards my career as a medical doctor.

To Robert, my husband and my friend for cheering me when the going got tough.

My mum Edith and siblings for their prayers, love and support.

To God Almighty my source of wisdom, knowledge and understanding.

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4. Colleagues, class of 2023- for their friendship and teamwork

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

BCVA	Best Corrected Visual Acuity
BETT	Birmingham Eye Trauma Terminology
CGI	Closed Globe Injury
ICD	International Statistical Classification of Diseases
IOFB	Intraocular Foreign Body
IOL	Intraocular Lens
IOP	Intraocular pressure
KEU	Kikuyu Eye Unit
KNH	Kenyatta National Hospital
MTRH	Moi Teaching and Referral Hospital
OCO	Ophthalmic Clinical Officer
OGI	Open Globe Injury
OTCG	Ocular Trauma Classification Group
RTA	Road Traffic Accident
SPSS	Statistical Package for Social Scientists
UON	University of Nairobi
VA	Visual Acuity
WHO	World Health Organization
PCO	Posterior Capsule Opacity

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background

Ocular trauma is a major worldwide problem to health. It can cause severe visual impairment or visual loss. Its impact can be felt at the individual and society level. It affects the cost, time spent accessing treatment and decline in economic productivity. Ocular trauma is preventable and public awareness may aid in reducing the occurrence of eye injuries.

The Anterior segment is the most commonly injured segment, and it requires meticulous repair in order to restore ocular integrity and avoid complications.

Objective

To determine the pattern, interventions and outcome of anterior segment injuries at the Kikuyu Eye Unit.

Study design and study centre

A retrospective hospital-based case series at Kikuyu Eye Unit, a high volume eye centre located in Kiambu County.

Participants and methods

Files of all patients with anterior segment injuries treated at Kikuyu Eye Unit, between 1st January 2017 to 31st December 2019, were retrieved. Patients with posterior segment injuries were excluded. Formula with finite population correction (Daniel WW 1999) was used to calculate the sample size.

Data management

Data was recorded using a questionnaire. It was input and analysed using Statistical Package for Social Scientists(SPSS).

The mean, median, and percentages were included in the descriptive analysis. They are displayed in tables and graphs as needed.

Results

A total of 503 files were retrieved, 296 with both anterior and posterior segment trauma excluded, and 207 studied. The male:female ratio was 2.4:1. The mean age of presentation was 19.3 years and the primarily affected age group was 1-10 years. The most frequent place where injuries occurred was at home (36.2%), followed by work place (20.8%). Stick was the most common causative agent of trauma (24.8%). Open globe injuries accounted for (65.4%), and right eye (53.1%) was the most commonly injured eye. Seven patients were injured in both eyes. The average time between injury and presentation to KEU was 3 days, and the average time between admission and surgery was 1 day. Corneal perforation was the most common presentation (45.8%) with corneal opacity being the most common complication (22.0%).

There was a statistically significant improvement in eyes that had post treatment best corrected visual acuity documented, $p<0.001$.

Conclusion

Anterior segment injuries occurred commonly in children and men. Most patient had open globe injuries, corneal perforation was the most common presentation. There was improvement in post treatment BCVA. This calls for preventive strategies by use of protective eyewear and supervised child play.

CHAPTER 1: INTRODUCTION

1.1 Background

Ocular injury is a serious threat to vision. Prompt and accurate diagnosis, coupled with effective treatment is essential to preserve vision.[1]

Trauma to the eye is a serious issue for public health globally. In developing countries, it is more common than in developed countries. It results in vision loss and blindness. In terms of cost, time spent, and economic output, it has a tremendous impact on both individuals and society.

Public awareness of safety measures may lead to a lower incidence of eye injuries.

1.2 Definitions

Ocular trauma refers to injuries following mechanical, chemical, radiation or thermal impact.

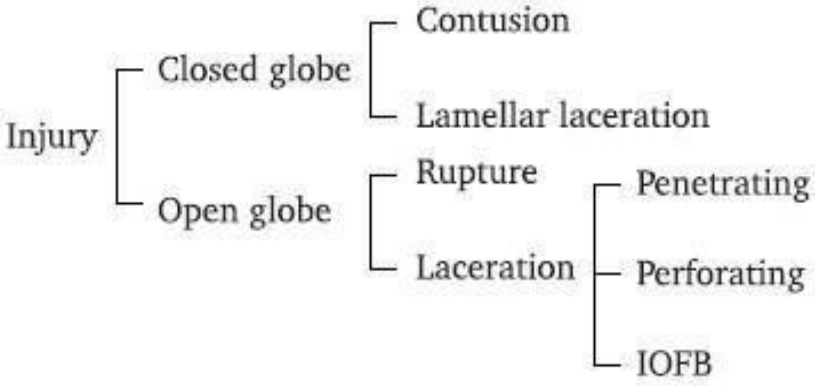
The term anterior segment includes the following parts of the eye: Conjunctiva, cornea, limbus, sclera, anterior chamber, iris, pupil and lens.

The Birmingham Eye Trauma Terminology system (BETT), is a standardized terminology system for mechanical eye injuries. It was created using a wealth of experience and several reviews. Several associations have approved it as the official worldwide language of ocular traumatology.[2]

The terminology system uses the entire eye as tissue of reference. It is consistent, straightforward, and unambiguous, with the definitions for the following regularly utilized terms for eye injuries:

Table 1: BETT classification

Terminology	Definition
Eyewall	Rigid structures of cornea and sclera.
Closed globe injury	Absence of a wound of full-thickness, characterized by a contusion, or a partial thickness laceration (lamellar).
Open globe injury	Complete thickness wound secondary to a laceration or globe rupture.
Globe rupture	Complete thickness wound of the eyewall at its weakest point as a consequence of blunt trauma.
Penetrating eye injury	Injuries that have an exit wound but no entry wound.
Perforating eye injury	Injury with both an entry and exit wound
Intraocular foreign body (IOFB)	Foreign items are retained in the eye, creating lacerations at the points of entry.



Another system for classifying eye injuries at the time of initial diagnosis was formulated by a committee of Ophthalmologists in America (The Ocular Trauma Classification Group) [3], to standardize ocular trauma classification. It classified globe injury according to the location of the wound as follows;

Table 2: Ocular Trauma Classification Group (OTS)

ZONE	**INJURY SITE**
1	Entire cornea and corneoscleral junction.
2	Injuries extending from corneal scleral junction to a point 5mm posterior to limbus i.e., anterior 5mm of the limbus
3	Injuries that extend from the anterior 5mm to the back of the sclera. That is, the most anterior aspect is 5mm posterior to the limbus

CHAPTER 2: LITERATURE REVIEW

2.1 Epidemiology of ocular trauma

Ocular injury is a substantial reason for visual morbidity making it a major public health issue. It is the commonest preventable cause of visual impairment.[4]

Around 1.6 million persons worldwide have bilateral blindness due to eye injuries, 19 million have unilateral visual loss with 2.3 million having bilateral visual impairment. Every year,750,000 people need to be admitted to the hospital, with 200,000 of them being open globe injuries[4].

The epidemiology of eye injury is preferably determined by population-based studies. In a study in the Chaoshan region of China, the annual occurrence rate of hospitalised eye injuries was 27.7 per 100,000 people in the Chaoshan region population[5]. However, most studies are hospital based studies.

In a hospital-based study in South India, anterior segment was the most involved at 51.1% of the injuries, followed by both the Anterior and Posterior segments at 31.4% and posterior segment alone at 8.9%[6].

Data that is accurate is critical for guiding in prevention and management which has been challenging to record due to different environments, a wide range of aetiologies and different data sources[7]

The true incidence of eye trauma in Kenya remains under-reported. Most of the studies in Kenya have been conducted in urban centres [8].

In a prospective research conducted by Kakembo et al at the Kenyatta National Hospital (KNH) in Kenya, ocular trauma accounted for 25.7% of eye ward admissions. The average number of patients admitted per month was 15.

2.2 Demographics and pattern of ocular injury in trauma

2.2.1 Sex and Age distribution

According to most research, young males are predominantly affected than females. This was attributed to the aggressive and risk-taking behavior in young men.

In a hospital-based study in India on the pattern of trauma to the anterior segment, there was a male preponderance of 77.9% (296 out of 354 patients) and 22.1% were female[9]. Other hospital-based research on ocular trauma in Africa, have found similar results [10] [11] [12]. In Kenya, a hospital-based study, by Momanyi et al at Moi Teaching and Referral Hospital (MTRH), male dominated the group, with a male:female ratio of 2.5:1[8].

Most injuries happened between 21-30 years of age (26.1%), followed by 0-10years age group (24.7%) in India[9], while in Swaziland, 50% of patients affected, on average, were between 20-39 years old, followed by 10-19 years old[10]

Eye injuries in the elderly may be attributed to poor vision due to cataracts, glaucoma previous eye surgeries and age-related degenerations. These factors may contribute to poor outcome[13].

Funjika et al in KNH, showed the vast majority of patients were between the ages of 20 and 29 years. This was attributed to the high-risk behavior such as high alcohol consumption exposing them to accidents.

2.2.2 Setting of ocular trauma

The setting of eye injuries varies. In most urban areas, industrial accidents and RTA (Road Traffic Accidents) were the commonest cause of eye injuries[14]. In rural areas, injury by vegetative matter was associated with agricultural work.[15]

In a population-based study in Chaoshan region in China, work-related injuries were the commonest 46.5%, followed by home-related injuries 20.1% and road traffic accidents 8.8%. A high rate of work-related injuries was attributed to lack of protective eyewear use [5].

In a prospective hospital-based study on Anterior segment injuries, carried out in rural India, most of the injuries occurred while working in agricultural fields (39.74%), followed by domestic work, industrial work and play[16].

Inoti et al in a review of eye injuries in KNH in children, most injuries occurred during child play[17]

Most injuries were found to occur at home, 30.7%, followed by farm/workplace 24.6% in MTRH Kenya[8]. This was consistent with other studies conducted in Swaziland where 43.11% occurred at home and 17.04% at the workplace[10] and in Ghana where 55% of the injuries occurred at home and 25% at workplace[11]

2.2.3 Types and aetiologic agents of ocular trauma

BETT system has classified ocular trauma to open globe injuries (OGI) and closed globe injuries (CGI) [2]. Different studies show a variation in ocular injuries.

Closed globe injuries were the commonest kind of injuries in a hospital-based study conducted in New Zealand, where 568 out of 821 eyes had CGI. This was in line with a hospital-based study in India where 50 eyes out of 78 (64.10%) had closed globe injuries and in Mbabane Hospital in Swaziland, 80% of the injuries were CGI[18 16 10].

Contrary to the above observations, in MTRH Kenya, open globe injuries were more common at 70%, with a similar finding by Muriithi et al in KNH at 66.7%[17]

In a clinical study on anterior segment injuries in rural India, sticks (17.95%), vegetative matter 14.10% wire 10.26%, sharp particles 10.26% were the commonest cause of injury[16], while in a hospital-based study in Ghana, organic matter(stick, wood, twig, cow's kick) were the commonest aetiologies[11]

In MTRH Kenya, the commonest aetiologic agent were sticks 30.6% especially in children, followed by stones 12.2%, nails 7.8% and metallic fragments 7.8%[8].

2.3 Anterior Segment manifestations in ocular trauma

Anterior segment structures can be injured in trauma with different patterns of injuries from eye to eye.

In a hospital-based study in India on anterior segment injuries, corneal manifestations were the commonest at 79.48%, out of this, 35.9% of patients presented with corneal lacerations, corneal abrasions were second at 21.79% and corneal ulcers 2.56%. Conjunctival involvement was second at 39.74%.Anterior chamber manifestation presented with hyphema, hypopyon and lens matter .[16]

Other manifestations in anterior segment injuries include iris prolapse, traumatic mydriasis, traumatic cataract, lens subluxation and dislocation[16], while in Ethiopia at a hospital-based

study, corneal lacerations were frequently observed 39.9% followed by damage to the lens 24.45%[19].

Conjunctival manifestations (laceration, foreign body chemosis and subconjunctival haemorrhage) were found to be the commonest in a hospital-based study in Swaziland[10]

In KNH Kenya, a study conducted by Misa et al, corneal perforations 64.9% and scleral perforations 45.3% were the commonest manifestations

2.4 Management of Anterior segment injuries

Management of anterior segment injuries involves non-surgical treatment, surgical treatment or both. Treatment may start at the site of an incident such as chemical burns or at the emergency department.

In the event of globe injury, meticulous initial repair is required to restore ocular integrity and minimize complications [20].

Deuri et al's study on anterior segment injuries, the majority of the patients, 56.41% required surgical intervention while 43.59%, were managed conservatively.[16]

In a hospital-based study in Ethiopia, the frequently performed procedure was corneal perforation repair (51.8%), the extraction of crystalline lenses or lens washout came in second at (21.4%)[19].

According to Momanyi et al study in MTRH Kenya, foreign body removal 48.3%, and corneal repair 9.9%, were the commonest surgical procedures done, other surgeries included anterior chamber and lens washout with primary intraocular lens (IOL) insertion. In severely injured globes, primary evisceration was done in 2.5% of eyes[8].

2.5 Complications of Anterior segment injuries

Structures of anterior segment undergo different patterns of complications in eye injury, with some structures having no complications.

In Ghana, a hospital-based study conducted by Bonsaana et al, 89.9% of the cases had no complications, 11% had complications, the commonest complication being corneal opacities[11].

In a hospital based-study in Swaziland, majority of eyes (79.6%) lacked complications at their last follow up. In eyes that had complications, corneal scars (9%), followed by refractive errors (5.6%) and phthisis bulbi (1.8%) were the commonest complications with refractive errors being attributed to astigmatism following corneal repair[10].

In MTRH Kenya, corneal opacity (16.7%) was the most common complication followed by phthisis bulbi (14.2%) and posterior synechiae (12%). Other complications included loose corneal sutures, posterior cortical opacities and endophthalmitis[8]

2.6 Outcome of Anterior Segment Injuries

In anterior segment injuries, the final visual outcome is influenced by a variety of factors.

In a hospital-based research on prognostic features of ocular injury in Singapore, there was a direct relationship between visual acuity at initial presentation and final visual acuity, with poor pre-op VA being associated with poor VA post-op and it was shown to be statistically significant $p < 0.001$ by fisher's test of independence.[21] However, in a hospital-based study in Lahore Pakistan, on visual outcome in anterior segment injuries, comparison between pre and post-op visual acuity was not statistically significant[22].

Open globe injuries carried a poor visual prognosis than closed globe injuries in a hospital-based study in Swaziland[10].

Other factors affecting visual acuity include crystalline lens involvement[21], size of intraocular foreign body with large IOFBs having a poorer outcome[23].

Those with early presentation had a better outcome than those who delayed to present to the hospital for treatment[24].

2.7 Justification

In most hospital studies, both locally and internationally, the anterior segment was found to be the commonest injured segment of the eye [6 10 8].

However, there is a scarcity of research on anterior segment injuries, as most studies conducted worldwide were on combined anterior and posterior segment injuries or posterior segment injuries alone.

No similar studies have been done in Kenya.

A study by Grace Nguyo et al in 2016 reviewed pattern and outcome of posterior segment injuries after ocular trauma at KEU [25]. The pattern and outcome of anterior segment injuries were not studied.

This study has provided information for evidence-based planning.

It may also aid in enhancement of safety strategies to prevent ocular trauma.

2.8 Study Objectives

2.8.1 Broad objective

To determine the pattern, interventions, and outcome of anterior segment injuries at Kikuyu Eye Unit.

2.8.2 Specific Objectives

1. To establish the types of anterior segment injuries in ocular trauma
2. To determine the aetiology of anterior segment injuries in ocular trauma
3. To assess the interventions provided in anterior segment injuries
4. To audit visual outcomes and complications of anterior segment injuries

CHAPTER 3: MATERIALS AND METHODS

3.1 Study design

The study was a retrospective hospital-based case series.

3.2 Study location

The research was done at Kikuyu Eye Unit (KEU), a high volume referral eye hospital in Kiambu County, Kenya. The hospital serves patients from both urban and rural settings. It has General Ophthalmologists, Subspecialty Ophthalmologists and Ophthalmic Clinical Officers (OCO) providing management to patients with anterior segment injuries.

3.3 Study population

Patients of all age groups, with anterior segment injuries, managed at KEU between 1st Jan 2017 to 31st December 2019, were included in the study population.

3.4 Inclusion and exclusion criteria

3.4.1 Inclusion criteria

Files of patients with anterior segment injuries who were managed at KEU from 1st January 2017 to 31st December 2019.

3.4.2 Exclusion criteria

Missing files.
Files of patients with posterior segment injuries confirmed by clinical examination or ultrasound.

3.5 Data collection procedures

The list of eye injuries cases was made from the department of medical records at Kikuyu Eye Unit, using the ICD-10 code for injuries to the eye.
Additional data was sought from the hospital's theatre register and ward register.
Data was recorded from the files, history details which include duration between injury and presentation, date of injury, injured eye, circumstances surrounding the injury i.e., home, work place or road traffic accidents. The cause of injury was also recorded e.g., stick, glass, nail etc.
Details of the injured eye which include visual acuity, intraocular pressure (where applicable) type of injury (open or closed globe injury) and anterior segment involvement was recorded.
The type of management; surgical and medical, was specified and recorded.
The preoperative, postoperative visual acuity and visual acuity at the last follow up visit was recorded.

3.6 Data management and analysis

Each questionnaire was assessed for completeness and data entered into a computerized database. The data was analysed with SPSS (Statistical Package for the Social Sciences).
Data evaluation was done as follows;

1) Demographic details-age, gender, occupation, residence
2) History- days between injury and presentation to KEU, date of injury, injured eye, circumstances surrounding the injury, the cause of injury, any past ocular disease, any systemic comorbidity and any treatment was provided before presenting to KEU
3) Examination- any significant systemic findings, Visual Acuity(VA), Intraocular pressure(IOP), open or closed globe, anterior segment structures involved
4) Investigations and treatment given
5) Post-op complications and post-op visual acuity

The study population was summarized by describing the clinical characteristics and demographics into percentages for categorical variables (outcome variables) and mean/median for continuous data. Visual outcomes was measured using visual acuity, while anatomical outcomes was presented as proportions.

KEU serves roughly 4000 patients per month, with 10-20 patients per month with ocular trauma.

A representative sample of the population during the period was drawn from the formula for finite population(Daniel 1999) was used to calculate sample size as follows;

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

Formula with finite population correction (Daniel WW 1999)

n^1 = Sample size with finite population correction

N = population size target =360 (10*12*3)

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

P = Estimated proportion of corneal lacerations 34.47%[9]

d =margin of error 6.9%

=120

3.7 Study Limitations

Some of the anticipated study limitations included;

- Missing data – this occurred due to inadequate documentation, by the clinicians, of relevant patients' information that led to certain variables not being analysed
- Loss to follow-up. Some patients opted to be followed up at their local facilities and this affected the study's outcomes

3.8 Ethical consideration

3.8.1 Confidentiality

Ensuring strict confidentiality, information from the files appeared in the questionnaire but not included in the final publication.
Patients' names were coded. The findings were referenced, analysed, and presented using these codes. Only the investigators and statistician had access to the information

3.8.2 Ethical approval

Study approval was obtained from KNH/UON Ethics and Research Committees and KEU administration.

3.9 Time frame/workplan

ACTIVITY	2021	2021	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022
	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
Development of research proposal and submission to ERC												
Data collection												
Data analysis and compilation												
Thesis submission and defense												
Dissemination of results												

CHAPTER 4: RESULTS

A total of 503 files of patients with anterior segment injuries were retrieved. Most patients (58.8%) had posterior segment involvement.

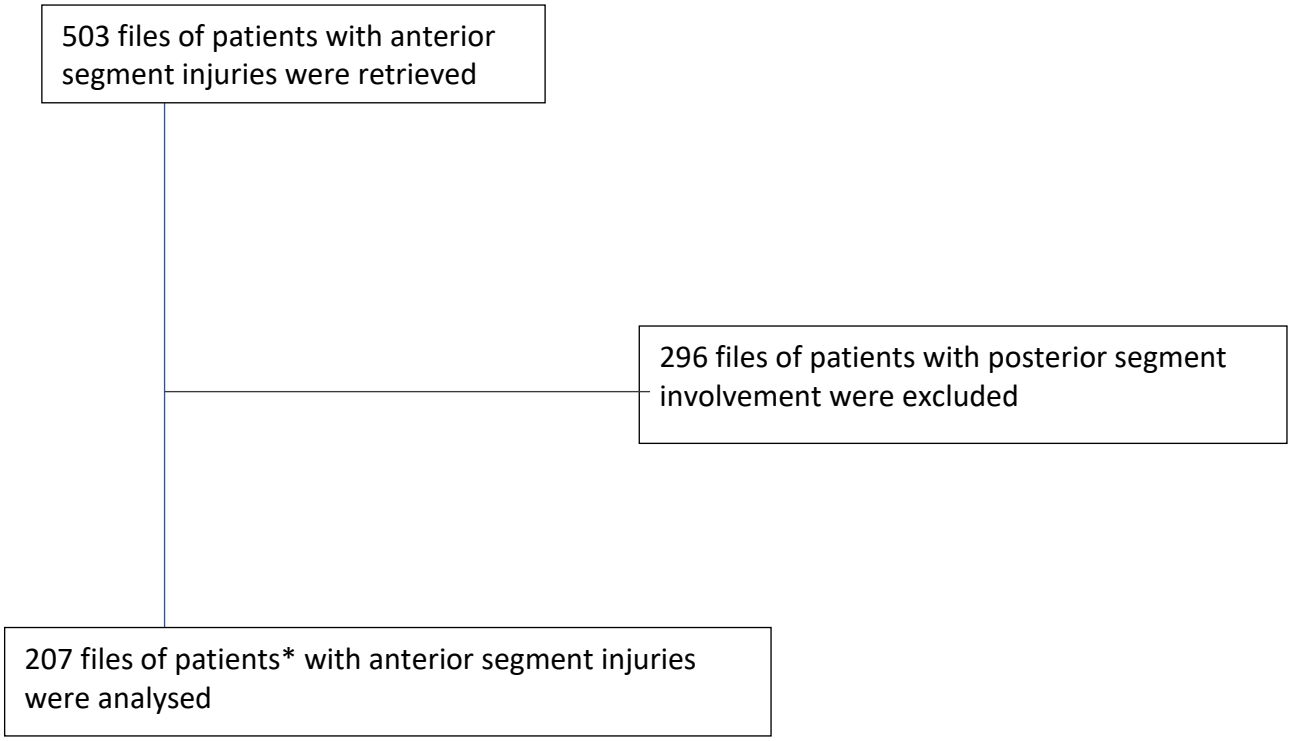


Figure 1: Flow chart of records of patients

Note; * Seven patients had both eyes injured.

4.1 Pattern of anterior segment injuries

4.1.1 Distribution of patients by catchment area (n=207)

Table 3 : Distribution of patients by catchment area

County	Number of patients	Percentage
Nairobi	51	24.6
Kiambu	35	16.9
Kajiado	22	10.6
Garissa	16	7.7
Machakos	13	6.3
Nakuru	13	6.3
Nyeri	10	4.8
Nyandarua	9	4.3
Laikipia	7	3.7
Embu	6	3.4
Kirinyaga	5	2.4
Narok	4	1.9
Meru	3	1.4
Kitui	3	1.4
Murang'a	2	0.9
Marsabit	2	0.9
Wajir	1	0.5
Taveta	1	0.5
Not recorded	4	1.9
Total	207	100

Majority of the patients in our study were from Nairobi County (24.6%).

4.1.2 Referral pattern (n=207)

Out of 207 patients, 167 patients were not referred while 40 were referred from other health facilities around the country.

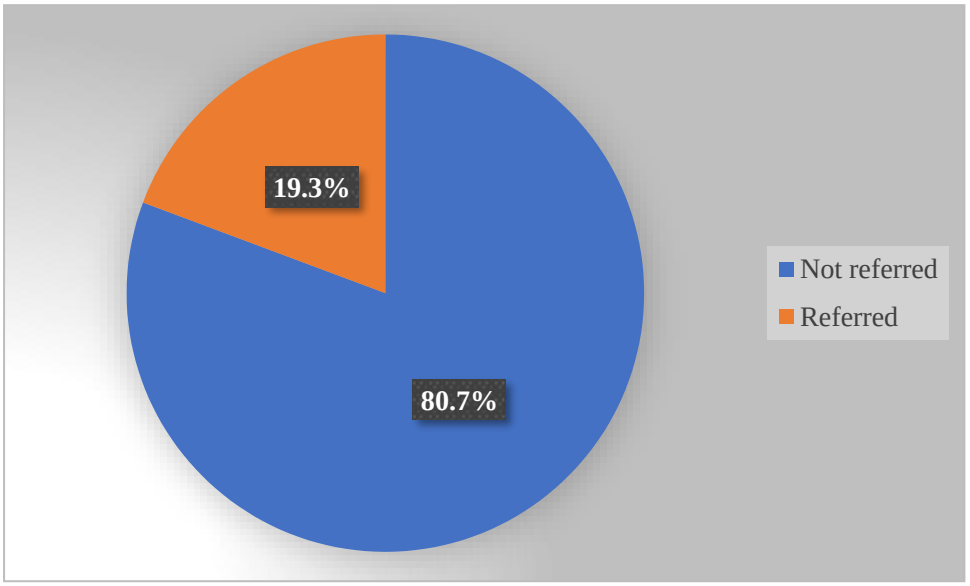


Figure 2 : Referral Pattern

4.1.3 Distribution of patients by sex (n=207)

Majority of the patients with anterior segment injuries were male (146), while (61) were female. The male: female ratio was 2.4:1.

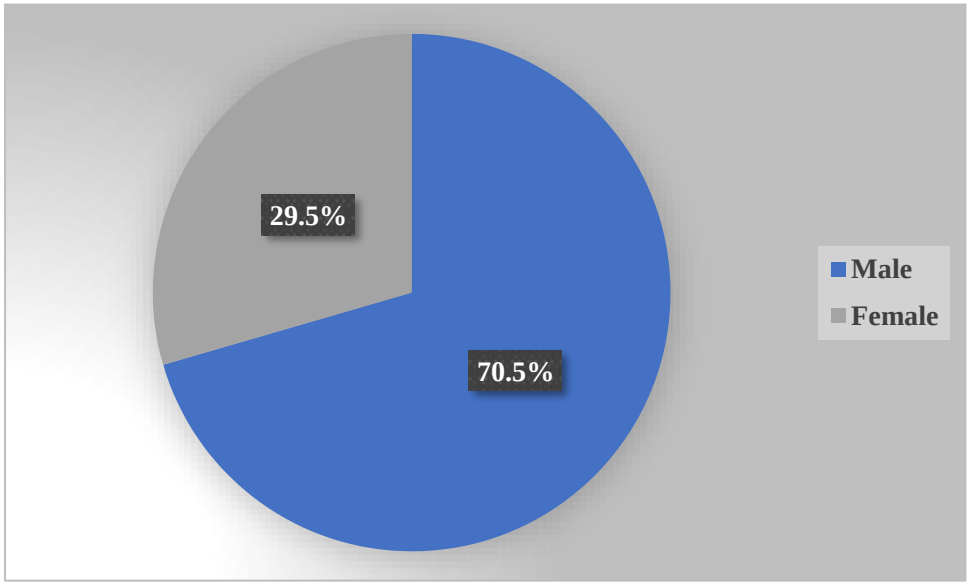


Figure 3 :Distribution of patients by sex

4.1.4 Distribution of patients by age (n=207)

In our study, the age range was between 1-66 years with most patients between 1-10years (81), followed by 21-30 years (35), 11-20 years (33), 31-40 years (32), 41-50 years (17) and 51-66 years (9). The mean age was 19.3 years ±15

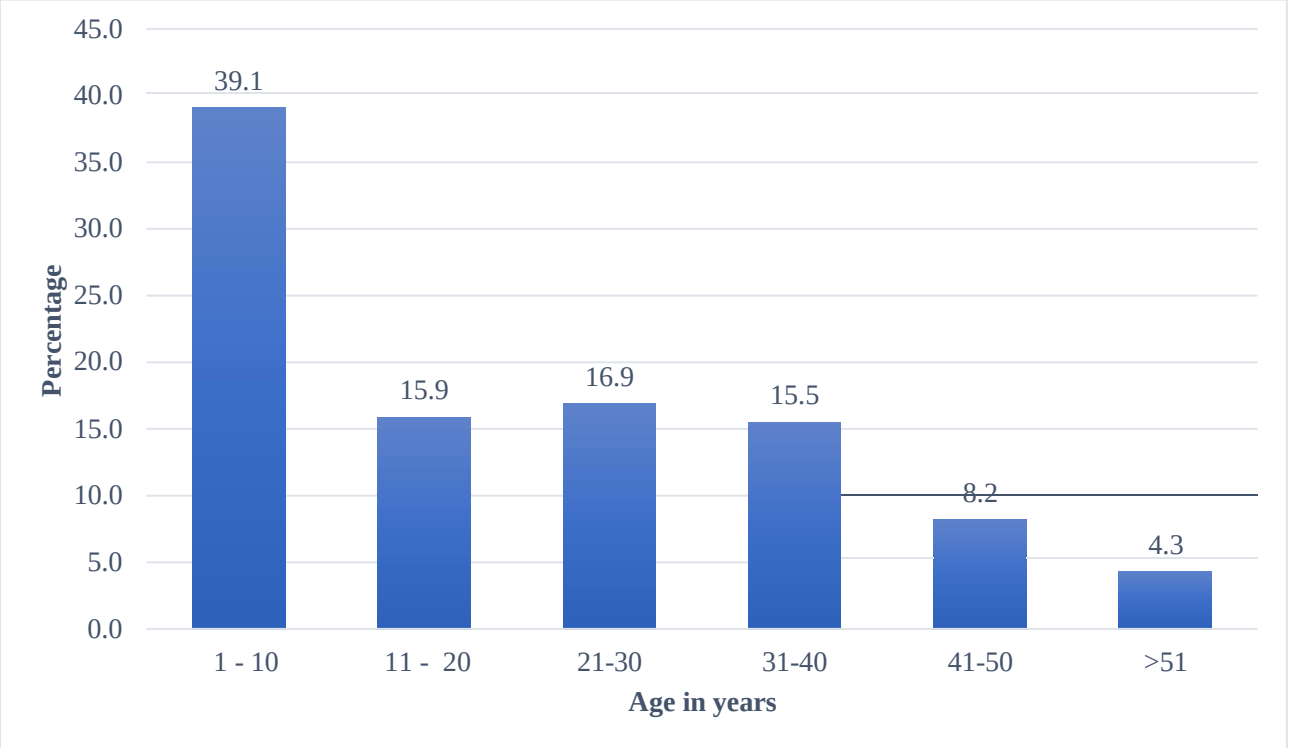


Figure 4: Distribution of patients by age

4.1.5 Occupation of patients (n=207)

In our study, the most common occupation recorded was student/children (90), followed by casual labourers (18), farmers (7), and business person (5). Others included security guards (4), barmen (4), car mechanics (3), teachers (2), and two were unemployed. Occupation was unknown/not recorded in 72 patients.

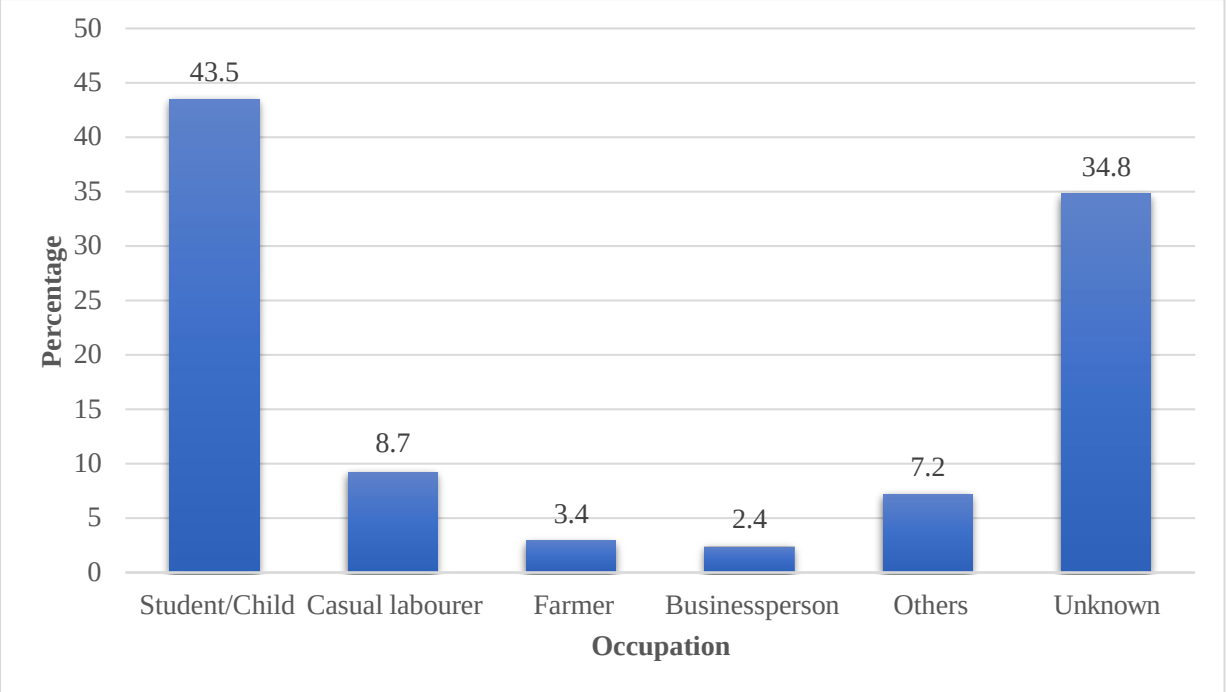


Figure 5: Occupation of patients

4.1.6 Setting of anterior segment injuries (n=207)

Table 4: Setting of injury

Setting	Number of patients	Percentage
Home	75	36.2
Work	43	20.8
School	18	8.7
Sports	12	5.8
Road traffic accidents	12	5.8
Assault (road side)	5	2.4
Nightclub	3	1.4
Unknown	39	18.8
Total	207	100

From our study, most of the injuries occurred at home, followed by work place.

4.1.7 Duration of injury and presentation to KEU (n=207)

Majority of the patients (70), presented to KEU within the first day of injury, while 39 presented 2 days after injury. Thirty- three patients took more than 7 days to present to the hospital. The range of presentation was between 1-90 days.

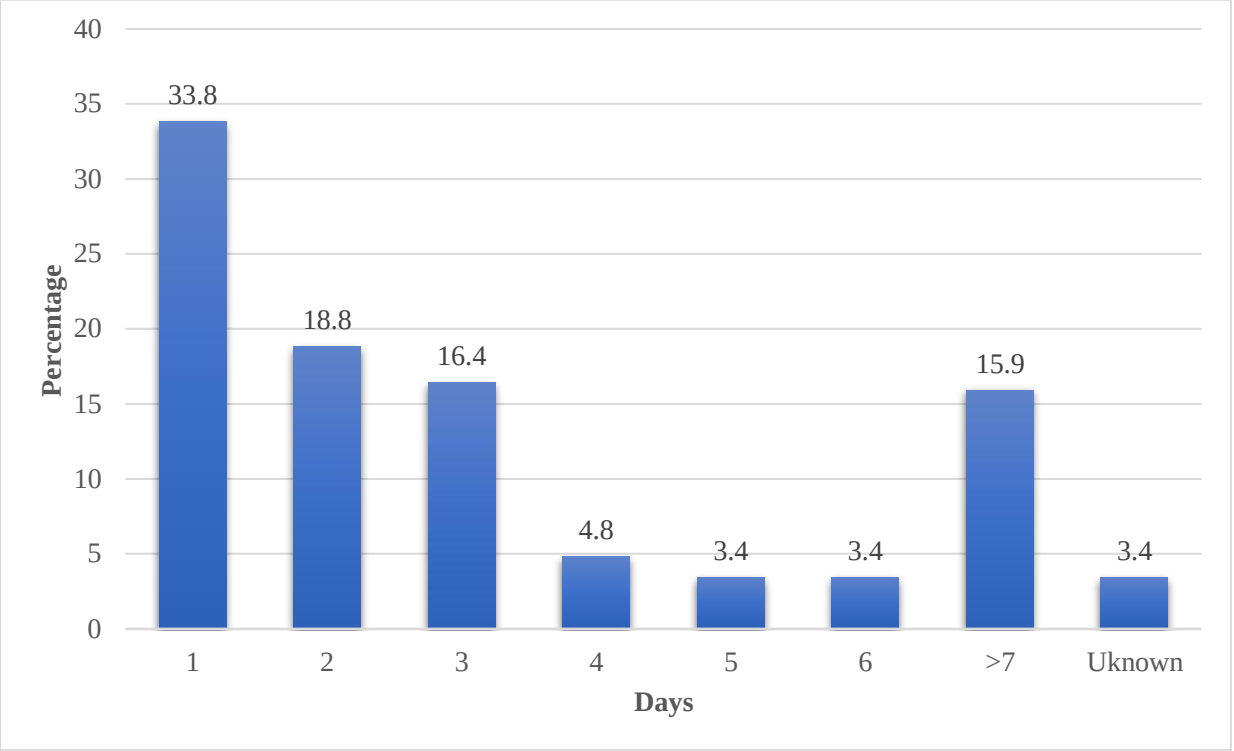


Figure 6: Duration between injury and presentation to KEU

4.1.8 Duration between presenting to KEU and intervention (n=207)

Most patients had medical or surgical intervention within 1 day of presenting to KEU (176), while 28 had surgical intervention two days after presenting, and 3 had surgical intervention after 3 days. The average duration between presenting to KEU and medical or surgical intervention was 1 day.

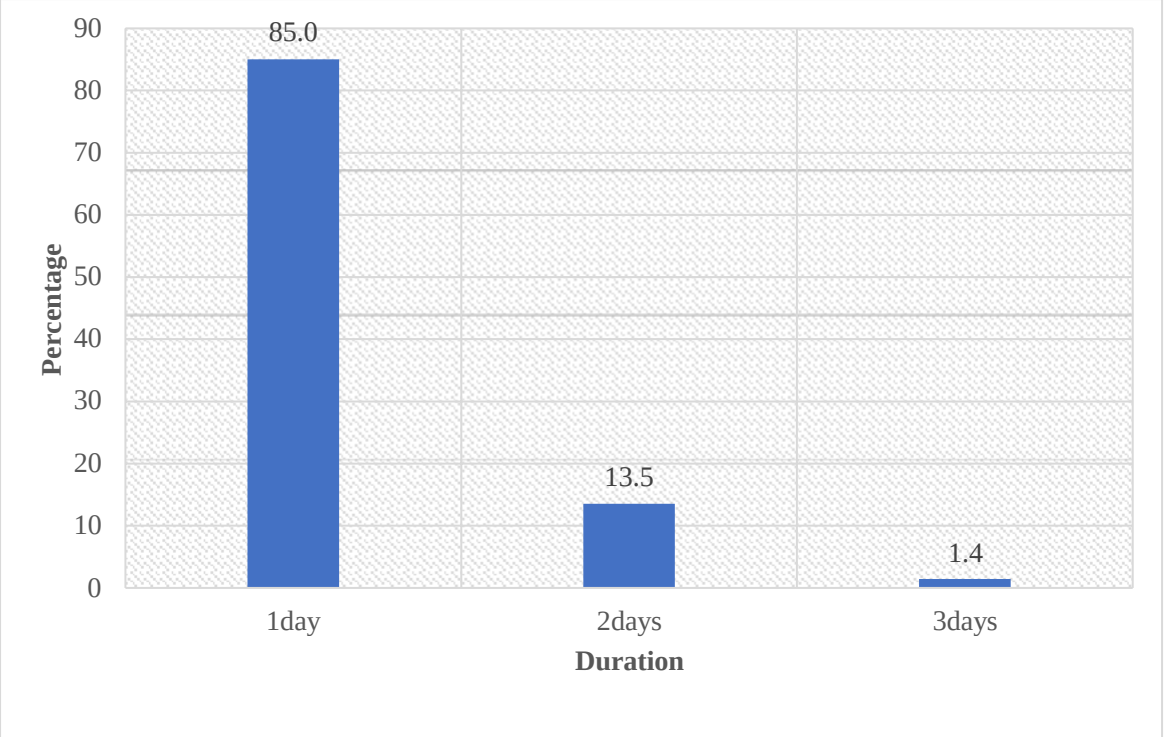


Figure 7: Duration between presentation and intervention

4.2 Types and causative agents of anterior segment injuries

4.2.1 Eye injured (n=207)

Out of 207 patients, most had injury to the right eye (110), followed by the left eye (90). Seven patients had both eyes injured.

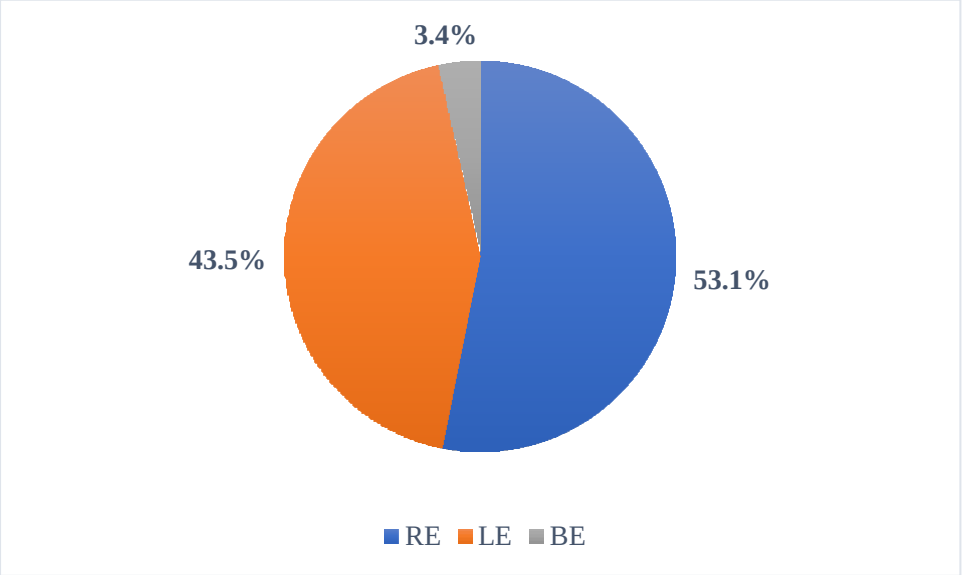


Figure 8: Eye injured

4.2.2 Type of globe injury (n=214)

Most eyes (140/214) had open globe injuries.

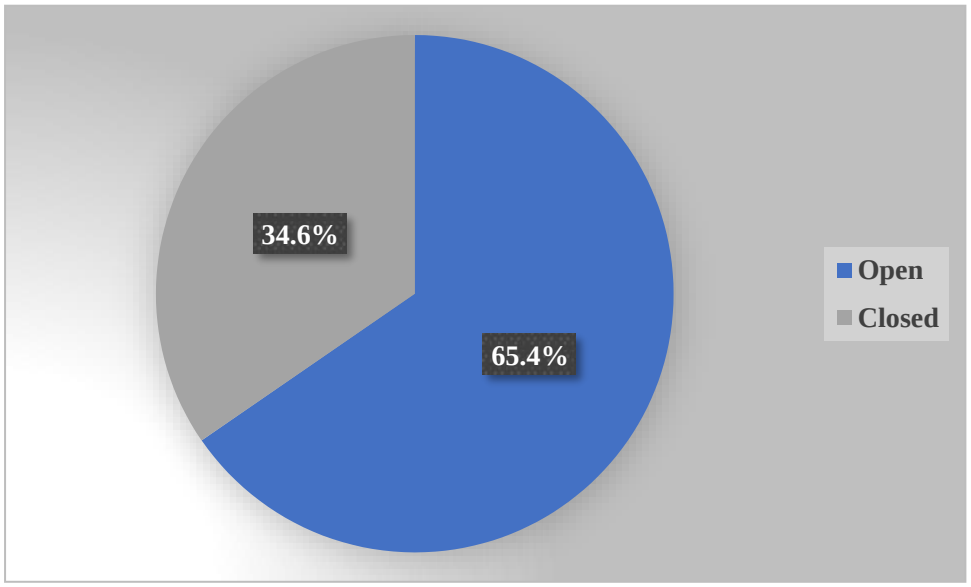


Figure 9: Type of globe injury

4.2.3 Causative agents (n=214)

Sticks was the most common object of trauma (53), followed by metals (25), stones (16), glass (12), body part (6), chemical (10), thermal (7), and others 39. In 46 eyes, the causative agent of trauma was not recorded. Among 'others' blunt objects (ball, cable, belt, door, falls) accounted for 84.5%. The rest included leaves, grains and scratch from animals (chicken and cats).

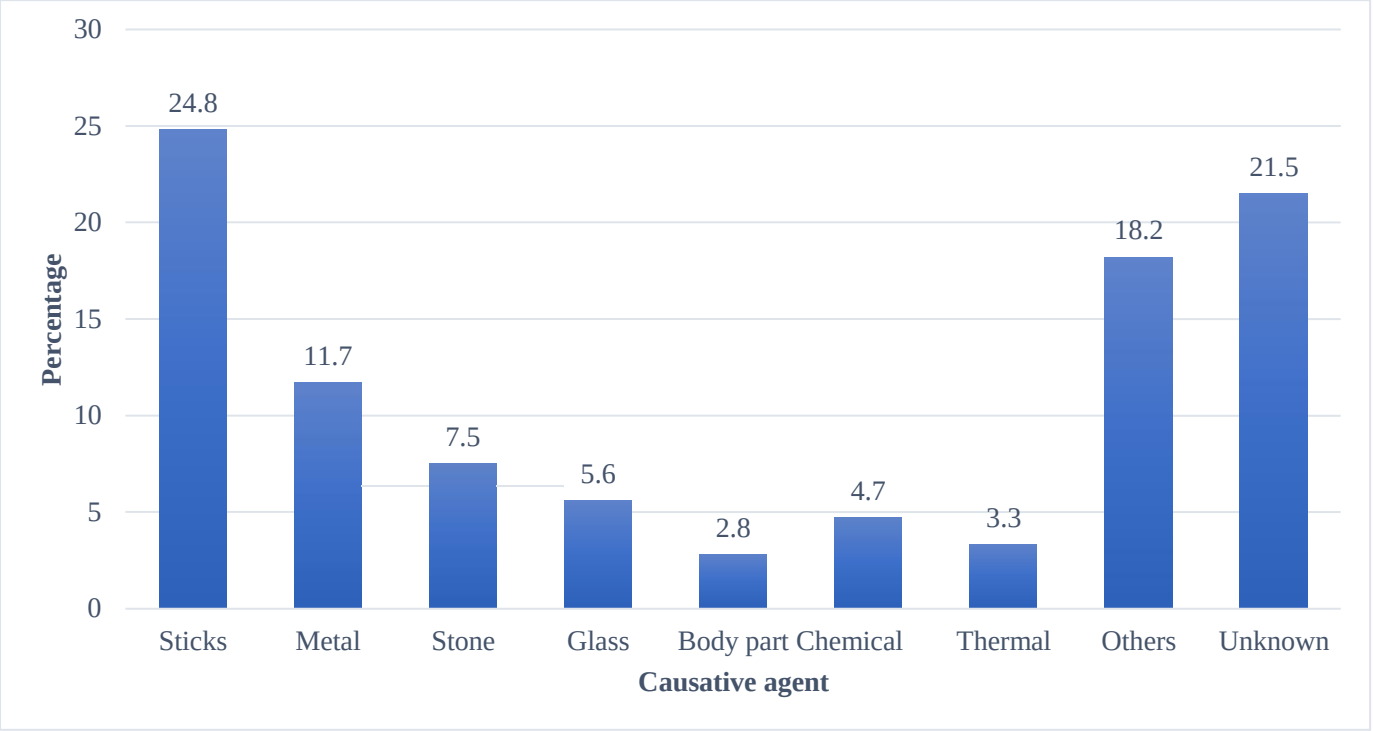


Figure 10: Causative agents

4.3 Anterior segment findings and intervention

4.3.1 Anterior segment findings (n=214)

Table 5: Anterior segment findings at presentation

Structure	Finding	Number of eyes*	Percentage*
Conjunctiva	Laceration	6	2.8
	Haemorrhage	40	18.7
Cornea	Foreign body	27	12.6
	Perforation	98	45.8
	Abrasion/epithelial defect	17	7.9
	Ulcer/Keratitis	11	5.1
Limbus	Laceration/perforation	8	3.7
Anterior Chamber	Hyphema	9	4.2
	Hypopyon	6	2.8
	Lens matter	18	8.4
Uvea	Iris prolapse	82	38.3
	Iridodialysis	15	7.0
	Uveitis	2	0.9
Lens	Cataract/rupture	72	33.6
	Dislocated	12	5.6

Note ;*Some eyes had more than one finding at presentation.

4.3.2 Interventions provided (n=214)

Table 6: Intervention provided

Intervention	Number of eyes*	Percentage*
1. Medical Management	62	28.9
2. Surgical Management		
Foreign body removal	25	11.7
Corneal perforation repair	96	44.9
Limbal repair	8	3.7
Anterior chamber washout	80	37.4
Intracameral antibiotics	15	7.0
Iris reposition/abscission	71	33.1
Lens surgeries +/- IOL	80	37.4
Medial rectus repair	1	0.5
Tenon repair	1	0.5
Tarsorrhaphy	1	0.5
3. Others		
Bandage contact lens	2	0.9
Irrigation	2	0.9
Corneal scrapping	2	0.9

Note: * Some eyes had more than one intervention.

Corneal perforation repair was the most common intervention provided.

4.3.3 Subsequent Interventions (n=214)

Table 7: Subsequent interventions

Intervention	Number of eyes*	Percentage*
Removal of sutures	46	21.5
Lens washout	7	3.3
Secondary IOL/repositioning	13	6.1
YAG capsulotomy	9	4.2
Synechiolysis	3	1.4
Posterior capsulotomy	6	2.8
Symblepharon release &MMG	1	0.5

Note: * Some eyes had more than one intervention provided.
Secondary IOL included scleral fixated IOL (SFIOL), sulcus and in the bag IOL

4.4 Outcome of anterior segment injuries

4.4.1 Visual outcome

Table 8: Table comparing pre-treatment VA and post-treatment presenting VA(n=214)

Visual acuity	Pre-treatment presenting VA	Post treatment presenting VA
6/6-6/12	48 (22.4%)	69 (32.2%)
<6/12-6/18	28 (13.1%)	26 (12.1%)
<6/18-6/60	33 (15.4%)	51(23.8%)
<6/60-3/60	21 (9.8%)	15(7.0%)
<3/60	51(23.8%)	16(7.5%)
Picks 100&1000 at 20cm	2 (0.9%)	3(1.4%)
Picks 3mm objects at 20cm	3(1.4%)	1(0.5%)
Not documented	9(4.2%)	8(3.7%)
Documented as irritable child/ uncooperative child	19(8.9%)	0
Didn't return post treatment	N/A	25(11.7%)
Total	214 eyes (100%)	214 eyes (100%)

Table 9: Follow-up presenting visual acuity at initial visit up to 1 year

Visual acuity	Pre-treatment VA	2-6 weeks	6weeks -3 months	3 months- 6 months	6 months-1year	1 year
6/6-6/12	48 (22.45%)	55 (31.6%)	49 (32.5%)	42(43.8%)	27 (39.7%)	17 (53.1%)
<6/12-6/18	28 (13.1%)	15 (8.6%)	12 (7.9%)	12 (12.5%)	6 (8.8%)	0
<6/18-6/60	33 (15.4%)	32 (18.4)	32 (21.2%)	19 (19.8%)	22 (32.4%)	6 (18.8%)
<6/60-3/60	21 (9.8%)	21 (12.1%)	14 (9.3%)	11 (11.5%)	6 (8.8%)	6 (18.8%)
<3/60	51 (23.8%)	48 (27.6%)	42 (27.8%)	10 (10.4%)	7 (10.3%)	3 (9.3%)
Picks 100&1000 at 20cm	2 (0.9%)	1 (0.6%)	0	1 (1.0%)	0	0
Picks 3mm objects at 20cm	3 (1.4%)	2 (1.1%)	2 (1.3%)	1 (1.0%)	0	0
Not documented	9 (4.2%)	0	0	0	0	0
Documented as irritable child/ uncooperative child	19 (8.9%)	0	0	0	0	0
Total	214 (100%)	174 (100%)	151 (100%)	96 (100%)	68 (100%)	32 (100%)

Table 10: Comparing pre-treatment presenting VA and BCVA at final visit (n=95)

Visual acuity	Pre-treatment presenting VA	BCVA at final visit	p value
6/6-6/12	17(17.9%)	51(53.7%)	x^2 =44.193
<6/12-6/18	8 (8.4%)	11 (11.6%)	p<0.001
<6/18-6/60	15(15.8%)	19(20.0%)	
<6/60-3/60	18(18.9%)	8(8.4%)	
<3/60	37(38.9%)	6(6.3%)	
Total	95 (100%)	95 (100%)	

There was a statistically significant improvement in visual outcome, with 53.7% of eyes having BCVA between 6/6-6/12, p<0.001

4.4.2 Complications of anterior segment injuries chi-square (n=214)

Out of the 87 eyes that had complications recorded, corneal opacity was the most common complication (47), followed by cataract (16), loose sutures (15), uveitis (12), refractive error (10), PCO (8), posterior synechiae (7), decentered IOL (5), hyphema (4), others included glaucoma,(3) endothelial staining(1), and staphyloma(1) .

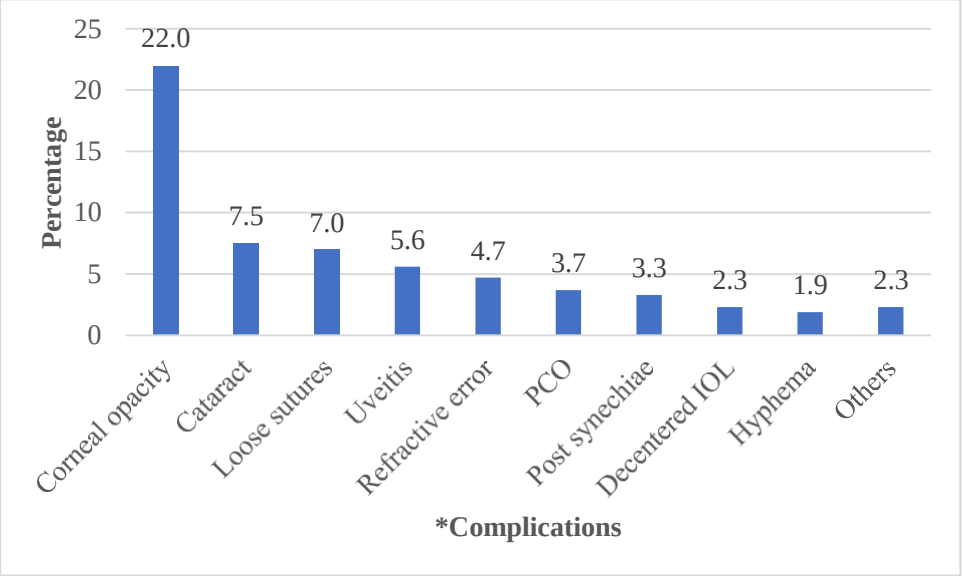


Figure 11: Post treatment complications

Note: * Some eyes had more than one complication.

The above complications were observed post treatment, either in isolation or in varying combinations.

CHAPTER 5: DISCUSSION

5.1 Pattern of anterior segment injuries in KEU

The patients in this study hailed from both rural and urban areas, with majority of patients from Nairobi County, followed by Kiambu County. The rest hailed from other counties such as Kajiado, Garissa, Machakos, Nakuru, Nyeri, Nyandarua, Laikipia, Narok, Embu, Kirinyaga, Meru, Murang'a, Kitui, Marsabit, Wajir and Taveta. Most of these counties have trained ophthalmologists.

Out of the 207 patients with anterior segment injury , majority had not been referred from other health facilities while 19.3% had been referred from other health facilities . These findings were similar to those of Bonsaana et al in Tamale hospital in Ghana where most patients were not referred 68.2% while 21.5% were referred from other health facilities[11].

Our study showed a male preponderance to anterior segment injuries, with males accounting for 70.5% . The male to female ratio was 2.4:1. This finding is in keeping with other studies. In India, Deuri et al found a male:female ratio of 2.9:1[16], while in Malawi, Zungu found M:F ratio of 2.8:1[12] . In Kenyan studies, Momanyi in MTRH found the ratios to be 2.5:1[8], in KNH 2.4:1 by Muriithi[17].This finding has been attributed to the fact that males are likely to be involved in high risk behaviour predisposing them to injuries.

The age spectrum in our study was 1 to 66 years with a mean age of 19.3 years (±15). The most impacted age group was 1-10 years (39.1%) and 21-30 years (16.9%). This finding was similar to a research done in Pakistan by Arfat et al on anterior segment injuries, where majority of patients were between 5-15years (24%)[22], and in Malawi, Zungu et al found most patients to be below age 11[12]. In Kenya, Muriithi found most patients to be between 4-9 years, and this was attributed to the fact that children above 5 years are school going , adventurous and their play is unsupervised, increasing their risk for injuries[17].

Patients above 50 years are less adventurous and unlikely to be exposed to injuries. In our study, patients above 50 accounted for 4.3% and had injuries acquired around home environment. In China, Wang found a bimodal distribution 1-10 years and 50-60 years and

attributed the injuries in the second age group to be due to comorbidities such as cataracts causing poor vision predisposing them to injuries[26].

In our study, the nature of patient's occupation was recorded in 65.2% files while 34.8% were not recorded. Most of the patients were children/students 43.5% followed by casual laborers. Other nature of occupation recorded included farmers, businesspersons, security guards, teachers, mechanics and barmen. Two patients were documented to be unemployed. The results of this study are in consistent with those of Bonsaana in Ghana[11] and Momanyi in Kenya[8] who found children/students to be more commonly involved 35.2% and 54.8% respectively. This causes burden in children's lives due to many Disability-adjusted life years (DALY).There was no documentation of use or non-use of protective eyewear in the work- related injuries and this calls for need to encourage use of protective eyewear to minimize incidence of eye injuries.

There was a predilection for the right eye 53.1% to eye injuries. Seven patients had injuries to both eyes, one was involved in a road traffic accident, one had a blast injury and five had burn injuries. This finding is similar to a study conducted in India by Sinha et al on anterior segment injuries where 68.4% had right eye involvement while 31.6% had left eye involvement[9]. On the contrary, Momanyi in Kenya, found the left eye to be the most involved[8]. Similarly, Funjika in KNH Kenya also found the left eye to be the most involved and related this to the right sided dominance causing vision in the left eye to be poorer than the right**.** This emphasises the fact that ocular trauma is a significant cause of monocular blindness**.**

In keeping with other studies, anterior segment injuries occurred mostly at home 36.2% followed by workplace 20.8%. In Swaziland 43.11% of injuries occurred at home, while in Kenya, Momanyi found most injuries to occur at home 53.6%[10,8].
In a study conducted in China by Wang et al, most injuries occurred at the workplace 39.6%, followed by home 28.4%[26].

The most common object causing anterior segment injury in our study was stick 24.8% followed by metals, stones, glass, chemical burns, thermal burns and body part in both adults and children. Among 'others' blunt objects (ball, cable, belt, door, falls) accounted for 84.5% the rest included leaves, grains and scratch from animals (chicken and cats).

Twenty one percent of patients did not have their causative agent of trauma documented. These findings are consistent with other studies; Deuri et al in India and in Kenya[16,8,17] where stick was the most common object of injury**.**

The Birmingham's Eye Trauma Terminology classification system (BETTS) was adopted in our study to categorize eyes with anterior segment injuries. Most of the eyes 65.4% had open globe injuries while 34.6% had closed globe injuries. These findings are in keeping with Momanyi et al in MTRH where open globe injuries accounted for 70% while closed globe injuries accounted for 30%[8]. Contrary to our findings, other studies had closed globe injuries as the most common type[16],[11].

Majority of the patients (70), presented to KEU within the first day of injury, while 39 presented 2 days after injury. Thirty-three patients took more than 7 days to present to the hospital. The range of presentation was between 1-90 days. These findings area similar to those of Deuri et al in India where majority of patients presented within 1-3 days of injury 51.2% and 29.1% within 1 day of injury[16]. In our study, late presentation might be attributed to poor road and transportation facilities, financial constraints, or lack of eye care awareness.

The most common injured part of the anterior segment was the cornea, with the most common finding being corneal perforation (45.8%), followed by corneal foreign body, and corneal abrasions. Corneal ulcers/keratitis accounted for 5.1% .A consistent finding with that conducted by Deuri et al on anterior segment injury of the eye in India, where cornea was the most injured part of the anterior segment 67.9%, with 35.0% patients presenting with corneal perforation, 21.7% corneal abrasion and 2.6% corneal foreign body[16].

In the anterior chamber, the most common finding was lens matter (8.4%), followed by hyphema and hypopyon. Iridodialysis was present in 7.0%, while iris prolapse was present in 38.3%. Lens involvement was observed in our study presenting either as traumatic cataract/ruptured lens or dislocated lens.

5.2 Intervention provided for patients with anterior segment injuries in KEU

Most of the eyes required surgical intervention 71.1% ,while 28.9% were managed medically. Most patients were treated within 1 day of presentation to the hospital (85.0%). This result may have been as a result of, KEU having an operating theatre that is always available for ocular emergency procedures. These findings were similar to those of Zwane in Swaziland and Momanyi in Kenya, where majority of patients were treated within 24 hrs[10],[8].

Most eyes received a combination of surgeries. The most common surgical procedure performed was corneal perforation repair (44.9%), followed by anterior chamber washout (37.4%) which was done for patients with hyphema and other corneal repairs. Lens related surgeries (cataract and lens washout) accounted for 37.4%. Other procedures performed include foreign body removal, iris repositioning ,and intracameral antibiotics, medial rectus repair, tenons repair and tarsorrhaphy. These results are consistent with research that was done in India on anterior segment injuries by Deuri et al and in Pakistan by Arfat where corneal repair and lens washout with IOL was the most common performed surgery[16,22].Other procedures performed included bandage contact lens application, irrigation and corneal scrapping.

Some eyes underwent subsequent interventions which included removal of sutures, lens washout , Secondary IOL/repositioning, YAG capsulotomy , synechiolysis , posterior capsulotomy , and symblepharon release.

Topical medication prescribed included antibiotics , steroids, analgesics , cycloplegics and glaucoma medication. These findings are similar to those of Momanyi, where antibiotics 92.2% , analgesics 35.7% and cycloplegics 22.7% were the most common medication used[8].

5.3 Outcome of anterior segment injuries in KEU

The WHO ICD-11 classification of visual impairment was adopted in our study.
The presenting visual acuity at initial visit was documented with majority of eyes having vision <3/60 (23.8%), followed by 6/6-6/12 (22.4%), with 2.3% of eyes having qualitative visual acuity recorded. In 4.2% of eyes, vision was not recorded while in 8.8%, vision was documented as irritable or uncooperative child and these were mostly children. Comparing

with other studies, Arfat et al in Pakistan found 38% with good vision (6/6-6/18)[22] while in Ghana, Bonsaana found most eyes with good vision at presentation 67.3% [11]. Poor vision at presentation has been linked to poor visual prognosis[5]. This calls for a need to emphasize on the use protective measures such as use of protective eyewear.

A significant improvement was noted in the post treatment uncorrected visual acuity with 32.2% eyes having vision 6/6-6/12, followed by 23.8% of eyes having vision >6/18-6/60. In 3.7% eyes visual acuity was not documented due to the lack of VA documentation during their admissions in in the wards, and these patients did not show up for their scheduled follow-up appointments.
Looking at the visual acuity at the different follow up periods upto 1 year, a significant dropout rate was noted after the 3 months. This may be due to improved vision hence patients did not see the need to be reviewed or some patients may have continued with management at peripheral facilities.

The WHO classification of visual acuity was adopted and used to compare vision at initial visit and eyes that BCVA recorded, with the association being statistically significant $p<0.001$.This finding was in keeping with other studies done locally and internationally[10,16,17]

In our study, complications were documented in 87 eyes, these were documented during the follow-up reviews and included; corneal opacity was the most common complication 22.0% followed by cataract, loose corneal sutures, uveitis, refractive error , PCO , posterior synechiae, decentered, hyphema and others . These findings are in keeping with studies conducted in Kenyan[8,17] and in Pakistan[22] where corneal opacity was the most common complication reported.

STUDY LIMITATIONS

While this study has given a review of anterior segment injuries, there was a possibility that a number of files of patients were missed, probably due to failure to include a diagnosis or omitting the word ‘trauma’ in the diagnosis leading to inappropriate ICD-classification.

CONCLUSION

In summary, the following conclusions were made from the study;

1. Open globe injury was the most common type of anterior segment injury
2. Sticks were the most common object of trauma with male being the most affected population
3. Home was the predominant setting of trauma followed by work environment
4. Most patients were treated within 1st day of presentation, with corneal repair being the most common surgical intervention
5. There was improvement in post treatment best corrected visual acuity at final visit, with corneal opacity being the most common complication

RECOMMENDATIONS

1. There is need for prevention strategies for anterior segment injuries particularly, in the paediatric age group

APPENDIX 1: QUESTIONNAIRE

DATA COLLECTION TOOL

A REVIEW OF ANTERIOR SEGMENT INJURIES AT KIKUYU EYE UNIT

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

1. **Personal details**
   - **a)** Patient code number _____
   - **b)** Age (years) _____
   - **c)** Sex M/F
   - **d)** Occupation _____
   - **e)** Residence _____

2. **Details of the injury**
   - **a)** Days between injury and presentation to KEU
   - **b)** If referred Y/N (*if yes, specify*) _____
   - **c)** Injured eye RE-1, LE-2, BE-3
   - **d)** Circumstances surrounding the injury(tick one response)
     1) Home
     2) Workplace
     3) Child play, (*specify place)* _____
     4) Farming
     5) RTA
     6) Sports-related
     7) Assault
     8) Other ,(*specify)* _____
     9) Not recorded
   - ***e)*** Cause of injury *(tick one response)*

1) Stick
2) Stone
3) Nail
4) Glass
5) Metal
6) Body part *(specify e.g., fist, elbow etc.)*
7) Chemical *(specify if acid/alkali)*
8) Thermal
9) Unknown
10) Others (*specify*)_____
11) Not recorded

f) Past ocular disease Y/N ☐

- Not recorded

if yes, *specify* _____

g) Any systemic comorbidity Y/N

- Not recorded

if yes, *specify* _____

3. Treatment before coming to KEU

Y/N ☐

If yes, *specify* _____

4. Examination

a) General

Any significant systemic findings ☐

If yes, *specify*_____

b) Ocular findings

i. General

- VA of injured eye _____
- IOP on admission measured Y/N ☐

If yes, RE_____ LE_____N/A_____

- Open globe/ closed globe (*tick one)*

ANTERIOR SEGMENT INVOLVEMENT	**Y/N**	**Specify**
Conjunctiva		
Cornea		
Limbus		
Anterior chamber		
Iris		
Lens		
IOFB (specify type and location)		

5. Investigations done

- OCT
- Ultrasound
- Microbiological investigations
- Others *(specify)*
- Not recorded

6. Treatment given

i. Medical management (*tick medications used*)

- Analgesic
- Steroids
- Glaucoma medication
- Cycloplegics
- Antimicrobials (*specify)* _____
- Others (*specify*) _____
- Not recorded

ii. Surgical intervention Y/N

If surgery was done,

Type of surgical procedure _____

7. **Complications** ***(tick where appropriate)***

Complications	Post-injury	Post-operative	Days after injury
Corneal opacity			
Loose corneal sutures			
Hypotony			
Synechiae			
Cataract			
Decentered IOL			
PCO			
Uveitis			
Endophthalmitis			
Phthisis bulbi			
Others *(specify)*			

8. Visual acuity at first and last follow up

	Date	Visual Acuity
1st follow up		
Last follow up		

APPENDIX 2: WHO Classification of visual impairment [27]

Categories	Degree of visual impairment	BCVA in the better eye
0	Normal vision	6/6-6/18
1	Visual impairment	<6/18-6/60
2	Severe visual impairment	<6/60-3/60
3	Blind	<3/60-1/60, or $<10^0$ but $>5^0$ visual field
4	Blind	<1/60-light perception or visual field $<5^0$
5	Blind	No light perception

APPENDIX 3 : Visual acuity conversion scale

Foot	Meter	Decimal	Log MAR
20/200	6/60	0.10	1.00
20/160	6/48	0.125	0.90
20/125	6/38	0.16	0.80
20/100	6/30	0.20	0.70
20/80	6/24	0.25	0.60
20/63	6/19	0.32	0.50
20/50	6/15	0.40	0.40
20/40	6/12	0.50	0.30
20/32	6/9.5	0.63	0.20
20/25	6/7.5	0.80	0.10
20/20	6/6	1.00	0.00
20/16	6/4.8	1.25	-0.10
20/12.5	6/3.8	1.60	-0.20
20/10	6/3	2.00	-0.30

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