PATTERNS OF HEAD COMPUTERIZED TOMOGRAPHIC SCAN FINDINGS IN PATIENTS WITH HEAD INJURY AT MOI TEACHING AND REFERRAL HOSPITAL.

BY

KIPCHIRCHIR CORNELIUS KOECH

A THESIS PRESENTED IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN RADIOLOGY AND IMAGING

DEPARTMENT OF RADIOLOGY AND IMAGING

SCHOOL OF MEDICINE

MOI UNIVERSITY

NOVEMBER 2013

Patterns of Head Computerized Tomographic Scan Findings in patients with Head Injury at Moi Teaching and Referral Hospital.

Investigator:

Koech K. Cornelius (MBChB (Nbi), Registrar in Radiology and Imaging,

Moi University School of Medicine

Supervisors:

Prof. G.D. Onditi Elias

Associate Professor, Department of Radiology and Imaging,

Moi University School of Medicine

Dr. Onchagwa E. N

Lecturer, Department of Radiology and Imaging,

Moi University School of Medicine

Declaration

<u>Student's Declaration:</u>

I declare that this research thesis is my original work, that it has never been presented elsewhere for academic purposes or otherwise. The research work was carried out while pursuing my Radiology and Imaging course at the Moi University School of Medicine.

Koech K. Cornelius

Sign ………………………………………………………………………………

Date ………………………………………………………………………………

<u>Supervisors' Declaration:</u>

This research thesis has been submitted for consideration with our approval as supervisors.

G.D. Onditi Elias

Sign ………………………………………………………………………………

Date ………………………………………………………………………………

Onchagwa E.N

Sign ………………………………………………………………………………

Date ………………………………………………………………………………

Acknowledgements

I would like to thank the Almighty God for His Guidance. I wish to thank my family for their support all through the research period. I wish to also thank my supervisors Professor Onditi Elias and Dr Onchagwa for their continued support, input and guidance in the writing of this thesis.

Patterns of Head Computerized Tomographic Scan Findings in patients with Head Injury at Moi Teaching and Referral Hospital

ABSTRACT

Background

It is estimated that about 10 million people are affected annually by head injury worldwide. It remains one of the most common reasons for seeking medical attention after injury. Most reports worldwide show that the main causes of head injury are road traffic accidents, falls, and assaults. CT scanning has become the mainstay in the diagnostic work-up and the Patterns of CT findings in head injury vary depending on cause and nature of injury. Data in developing countries is scarce and thus the need to undertake more studies to establish the patterns of head CT Scan findings in head injuries.

Objectives

To describe the patterns of Head CT Scan findings in patients with head injury.

Study Setting

Moi Teaching and Referral Hospital (MTRH), Radiology and Imaging Department.

Design

The study was a cross-sectional survey.

Study population

Patients with head injury who underwent head CT scan at Moi Teaching and Referral Hospital.

Methods

The study involved patients with head injury, seen at MTRH and underwent head CT scan. The study was for a period of 8 months from October 2011 to June 2012. Analysis involved the variables patterns, age, sex and cause of head injury and their correlations.

Results

A total of 275 patients were seen during the study period. The mean age was 32.91years with SD of 18.43 years. Majority had mild head injury (52.73%) and were mostly young adults (21-40 years). Males were 240 (87.3%) and females 35 (12.7%). The commonest causes were assault 41.5%, motor vehicle accident 29.5%, Falls 12.7% and motor cycle injuries 12.4%. Abnormal CT Findings were seen in 200 cases (72.7%) and normal CT in 75 (27.3%). The most common abnormal CT findings were Intracerebral bleed 18.5%, extradural hematoma 12.4%, and depressed skull fracture 20.7%. The Elderly and very young had more severe injuries.

Conclusion

Intracranial hematomas were the leading CT Findings. Assault and motor vehicle injuries were the leading causes. CT Scan provides an accurate non-invasive diagnostic modality, gives detailed pathological findings and facilitates therapeutic management.

Contents

Figures and Tables

Figures

Tables

Abbreviations

IREC	Institutional Research and Ethics Committee
MTRH	Moi Teaching and Referral Hospital
WHO	World Health Organization
EDH	Extradural Hematoma
SDH	Subdural Hematoma
DAI	Diffuse Axonal Injury
HI	Head Injury
MVA	Motor Vehicle Accidents
CT	Computerized Tomography
GCS	Glasgow Coma Scale
DALY's	Disability Adjusted Life Years
CDC	Centers for Disease Control and Prevention
RTA	Road Traffic Accident
OS	Oxidative Stress

Definitions

Head Injury

Any injury that causes a lesion or functional damage of cranium, meninges and brain.

Adult

Adult as anyone with the age of 18 years and above.

Adolescent

This is anyone aged between 14-18 years

Mild head injury

Mild head injury is defined as patients with GCS score of 13–15.

Moderate head injury

Moderate head injury is those patients with GCS score between 9-12

Severe head injury

Defined as patients with GCS Score less than 8

Children

The patients with age less than 12 years.

Positive CT scan

One that demonstrated an acute pathological state in the skull or brain attributable to head injury (vault or basilar fractures, epidural, subdural, intracerebralhaematomas, contusions, intraventricular hemorrhage, pneumocephalus).

Multiple lesions

More than one lesion eg: epidural haematoma, contusion, subdural haematoma ,pneumocephalus, contusions in more than one location etc.

Loss of consciousness (LOC)

Patients who were amnesic for the traumatic event, or gave a history of LOC or had witnessed a LOC.

Focal neurological deficits (FND)

Weakness of one or more extremities, dysphasia, unequal or asymmetrically reactive pupils, abnormal eye movements, Babinski reflex, cerebellar signs.

Chapter 1: INTRODUCTION

1.1 Background

Head injury (HI) is defined as any injury that causes lesion or functional damage of scalp, cranium, meninges and brain. It is a major public health problem worldwide and is associated with high morbidity and mortality both in developed and developing countries[1]. It is the most frequent lesion seen in trauma related-death[2]. In developing countries including Kenya, head injuries in particular are increasing due to increase in road traffic accidents[3].

The causes and patterns of head injuries vary from one region to another due to variations in geographic patterns, cultures, and different socio-economic factors. Road traffic accidents (RTA) are the commonest cause of head injuries and are especially common in young adults who are economically active[4,5]. It was noted to account for 49.2% of head injured patients in Bugando Tanzania[6]. Falls are also a significant proportion of head injury, particularly in young children and elderly people[7] as was seen in Orotta Eritrea to account for 36.4% of head injured patients[8]. Assault is a common cause of head injury in some places, particularly in economically depressed and densely populated urban areas where interpersonal aggression is high. This was shown in the Bronx and inner Chicago to be the leading cause of head injury[9]. Alcohol intake is an important factor in the etiology of head injury[7] and is a common feature of victims of road traffic accidents, assaults, falls and suicides[10]. Odero*et al* 2003 found that it was a common finding in drivers who had head injury due to road traffic accidents[3]. Head injuries are often associated with injuries to other body parts which include abdominal and chest injuries. Musculoskeletal injuries are the commonest extra-cranial injuries sustained following trauma[1,11].

Head injury remains one of the most common reasons for seeking medical attention after injury[12] and CT scanning has become the mainstay in the diagnostic work-up of the patient with head injury[13, 12, 14]. Historically, imaging of head injured patient involved skull radiographs[15, 16] and the first recorded account of injuries is in the Edwin Smith Papyrus (written over 5000 years ago) which gives an account of 48 different types of injuries with an approach to the wounded individual[17]. Most physicians rely on clinical criteria such as GCS score, loss of consciousness, and mode of injury to predict the probability of intracranial lesions. However, some studies have shown that a normal neurological examination does not reliably rule out intracranial lesions[12]. Most of the studies that have been conducted to evaluate the incidence of intracranial injuries and the clinical predictors of positive CT are retrospective[12,18] and variations in incidence of positive CT scans do occur due to different inclusion and exclusion criteria's used. Many patients with mild head injuries either seek no medical attention or they attend hospital and are sent home after assessment, thus data on such cases depend on specific surveys because no routine records are kept for such cases[10]. A significant proportion of survivors of head injury are left with disability and Kraus et al[19] found an annual incidence of those left with disability being 33-45 per 100,000[10]. Moscato et al in a household survey in Canada found 54 per 100,000 having at least six months of disability. The management of patients with head injury requires a well coordinated, comprehensive and multidisciplinary approach for optimal treatment outcome[6]. Majority of head injuries are preventable and a clearer understanding of the causes and injury patterns is essential for guiding preventive strategies as well as approach to patient management. Such data will be crucial in our environment. The objective of this study was to determine the patterns of head computerized tomographic scan findings, their causes and severity of head injury in relation to age, cause and gender in our setting.

1.2 Problem Statement

Head Injury is a common cause for admission at trauma centers and hospitals.

It arises from various causes the leading being motor vehicle road traffic accidents. It imparts heavily on the economy in regard to the cost of hospitalization and increasing mortality. The majority of these accidents are preventable.

In Kenya, road traffic accidents have increased over the last decade and this has resulted in increased number of head injuries[20, 21]. Latin America and Sub Saharan Africa demonstrate a higher head injury related incidence rate varying from 150–170 per 100,000 respectively due to Road Traffic Accidents compared to a global rate of 106 per 100,000[22].

Developing countries bear the brunt of the fatalities and disabilities from road traffic crashes, accounting for more than 85% of the world's road fatalities and about 90% of the total disability adjusted life years (DALYs) lost due to road traffic injuries[23]. The problem is increasing in these countries at a fast rate, while it is declining in industrialized nations (Odero et al 2003)[3].

This leads to increased incidence of head injuries in these countries. According to the Centers for Disease Control and Prevention (CDC), approximately 1.4 million people suffer Head Injury each year in the United States and about 50,000 people die from the injury. The patterns of findings in head injury in our setup are not fully known thus a need to study them in more detail in this region.

1.3 Justification

Head injury is a leading cause of death, morbidity and disability in many countries as well as in Kenya. Globally It is estimated that about 10 million people are affected annually by head injury worldwide[22,24] and in developing countries accident rates and traumatic brain injury are increasing as traffic increases besides other factors like industrialization and falls[16]. According to World Health Organization published research (Murray & Lopez, 1996) it estimated that in the rank order of leading causes of " years lost due to death and disability", road accidents would change from being the 9th leading cause in the world in 1990 to the 3rd most major cause by 2020[23]thus in order to prevent them, there is a need to identify causes, and to implement strategies to reduce their occurrence.

In Africa, there has been an increase in the incidence over the last decade due to the increasing number of road traffic accidents. About 10 percent of global road deaths in 1999 took place in Sub- Saharan Africa where only 4 percent of global vehicles are registered. This has led to a significant increase in the number of head injuries. Given the widely recognized problem of under –reporting of head injuries in Africa, the true figures are likely to be much higher[25,26].

In Kenya, the pattern is similar and it has one of the highest road fatality rates in Africa at 68 deaths per 10,000 registered vehicles annually, and between 45-60% of admissions to surgical wards. The nationally available data on road crashes in Kenya and resultant injuries are based on data collected by the police who attend to road traffic crashes or have details reported to them. The injury severity is classified into only three broad categories: slight, serious or fatal[27]. This limits the data regarding the true nature of head injuries in our setup thus the need to undertake more studies. This study thus aims to establish the patterns of head injuries in this set up in more detail.

1.4 Objectives

1.4.1 Main Objective:

To describe the patterns of Head CT Scan findings among patients with head injury attending The Moi Teaching and Referral Hospital (MTRH).

1.4.2 Specific Objectives:

1. To assess radiologic patterns of computerized tomographic (CT) scan findings among patients with different degrees of head injury seen at MTRH.
2. To establish the main causes of the head injury among patients attending MTRH.
3. To determine the association between the level of severity of head injury and causes, age and gender.

1.5 Research Questions

This study aims to answer the following questions:

1. What are the patterns of head computerized tomography findings in patients with head injury at MTRH?
2. What are the different causes of head injuries?
3. What is the severity of head injury among patients in relation to age, etiology and gender?

1.6 Aims of the Study

To establish the patterns of head computerized tomography findings in patients with head injury at MTRH, their causes, and severity of head injury in relation to age, cause and gender.

Chapter 2: LITERATURE REVIEW

Head injuries are one of the leading causes of death and disability worldwide[1, 16,28,29]. Although many head injuries are minor[30], because of the devastating effects of moderate and severe head injuries, they constitute an important public health problem[1, 31, 12, 32]. Head trauma is a very brief event, which occurs in less than 200 milliseconds, and often in less than 20 milliseconds[33]

2.1 Epidemiology of Head Injury

The prevalence of head injury varies widely. Most of the figures quoted are based on studies in the United States and the annual incidence of head trauma is estimated to be 180-250 in 100,000 population[33, 34, 29]. Epidemiological studies have demonstrated that about 80% of all patients hospitalized for an acute brain injury suffer from a mild head injury[5, 32].

The annual incidence is estimated at 2.2 in 1000 and the peak age being 18-20 years and male/female ratio 2.19:1[35]. In a study in Eritrea by Mebrahtu et al, annual increase was found to be 0.1% and male to female ratio being 3:1[8]. The incidence of traumatic intracranial hematomas and their outcome depend on age, cause, time since head injury and clinical condition of the patient[31].

It is estimated that 1.5 million people are treated for head injury annually in the US[36, 37, 38]but data in our country is scarce.

The cost of traumatic brain injuries in the United States is estimated at 48.3 billion dollars annually[22] and in our country with the high number of road traffic accidents causing head injuries, it is thought to be relatively high[20, 3].

2.2 Etiology of head injury

Head injury arises as a result of different causes. Trauma is the leading cause of head injury and death both in children and young adults[39, 40,41,29], and head trauma is the cause of death in more than 50% of trauma patients[42.] It is also the leading cause of death among those aged 1-24 years[3] and in patients with multiple trauma, head is the most common organ involved[33].

The leading cause of head injury is road traffic accidents and in adults, motor vehicle accidents is the commonest cause[33,5]. This is thought to be as a result of poor state of roads having potholes, over speeding, overloading and driving under alcohol influence. These are most of the factors found to be contributing to most of the head injuries due to road accidents in kenya[3]. Aggrawal et al in a study of head injuries in Nepal found that road traffic accident was the most common cause 43.4% [1] and it correlated with puvanachan et al in a study in Iran who also found that motor vehicle accidents were also the leading cause at 32.9% and falls being the second[24]. In Kenya, road traffic accidents are among the leading causes[4]. Traffic in developing countries is different from that in developed countries and motorized two wheeler accidents are relatively common, thus contributing a significant amount of patients with head injuries[43].

Assaults are a common cause of head injury where it involves being hit by a stone, metallic object or wooden objects on the head. This results in different degrees of head injuries and other associated injuries[8]. It is common in both rural and urban areas, where there are quarrels and alcohol intoxication. According to Bordignon et al interpersonal aggression was the commonest cause 17.9% followed by falls 17.4% Automobile accidents were the third 16.2%[2]. This shows a different variation from many studies which showed motor vehicle accidents being the commonest. Alcohol intoxication has been documented as being a significant factor in the etiology of head injury due to assaults resulting from quarrels when drunk and hence leading to fighting.[2,7]. Odero *et al* (1995) also found assault to be the leading cause of head injury at 40%[44].

Falls have been found to be a relatively common cause of head injuries and especially in children where they fall from heights e.g. trees. This is most common during seasons when fruits have ripened e.g. mangoes and guavas and children climb to pick them. The age group 10-18 yrs is the most involved[33]. Elderly people have been found to also suffer head injuries when they trip and hit their heads on the ground. This has been found to result in an increased rate of chronic Sub-dural hematomas as these are often picked later on during CT Scanning because of chronic headaches. In a study in Brazil, falls were found to constitute 17.4% of all head injuries and most were associated with alcohol abuse in the elderly[2].

With the increasing use of motorcycles as a means of transport especially in Kenya, there has been an increase in the incidence of head injuries and this has been as a result that most drivers and passengers do not wear helmets while being transported[45],[3]. This was similarly found in Mwanza Tanzania where motorcycle injuries constituted 37.2% of all road traffic accidents and musculoskeletal 60.9% and head injuries 55.2%, were the commonest findings[11]. Bicycle accidents have also resulted in increased number of head injuries particularly in children who use bicycles for their plays and it is also common in sports involving cycling.[2,28,46].

Gunshot injuries contribute a significant portion of head injuries and are on the increase globally and have wide regional variations especially in areas where conflicts are common involving use of guns e.g. areas with spates of communal and ethnic clashes, political violence and armed robberies and this causes devastating intracranial injuries due to the large amount of energy dissipated within the brain tissue itself. Ojo et al showed that there was substantial morbidity and mortality in North-western Nigeria and intentional injuries occurred in (76.5%) patients and (65.5%) were caused by armed robbery[47].

2.3 Age and Gender distribution

The most affected age groups are those in the second and third decades of life and the incidence of head injury is nearly three times as common in males as it is in females with motor vehicle accidents being the commonest cause[48]. This was similarly found by Aggrawal et al to be male to female ratio of 2.6:1[1]. In a study in Eritrea the highest frequency of head trauma occurred in the 21-30 year old group (22.7%)[8] and H.C Chan et al in a study of mild head injured patients in Malaysia found that the young productive age group was mainly affected and males were more than females[49]. Pedestrians in their third decade of life have been found to be the most affected[50] and the peak incidence for pedestrian injuries has been reported at 6–12 years[51]. Mezue et al in a study of head injury patterns in Qatar also found pedestrians to have sustained more severe head injuries than motor vehicle occupants[52].

In infants and children under 12 years of age, trauma has been noted to be a common cause of morbidity and mortality, and automobile accidents being the leading cause (43.4%) of the head trauma.[53]

2.4 Clinical presentation

Patients with head Injury have a varied array of manifestations. They are usually brought as conscious, semi -conscious or unconscious and this is quantified according to the Glasgow Coma Scale as mild, moderate or severe head injury.

The patients may have penetrating head injuries and resultant open skull fractures, or depressed skull fractures. In a study at Bugando Medical Center Tanzania, it was found that most patients who had Road Traffic Accidents had penetrating head injuries[6]

Those with gunshot injuries to the head usually have compound skull fractures and associated intracranial hematomas due to the significant laceration of the blood vessels. Most of them later develop subsequent neurological deficit[47].

Patients with head injuries also have associated injuries in other body parts including abdomen, chest, musculoskeletal due to the nature of etiology of the head injuries and this has been shown to contribute a significant percentage of the mortality of these patients[1,6,11]

Majority of patients are reported to have Loss of Consciousness immediately after the head injury[54] and this has an association on the features demonstrated on the CT Scans[55]. This has showed that the longer the loss of consciousness, the worse the intracranial pathology and Dalt et al (2006) found Significant association between intracranial injury and loss of consciousness, prolonged headache, persistent drowsiness, abnormal mental status and focal neurological signs and the risk of fatal intracranial injury was 0.5 per 1000 and non fatal intracranial injury was 5.2 per 1000[56].

Even though majority of the lesions on CT scan do not require neurosurgical intervention as most of the head injuries are minor head injuries, Causes of surgical intervention for intracranial lesions include compound depressed fractures, decompression of contusion, and evacuation of intracranial hematomas i.e Extradural and Subdural hematomas, and suturing of scalp lacerations[57].

2.5 Computerized Tomographic Scan (CT) Findings

Features identified in CT scan are variable, and depend on the type of head injury and cause. They can vary from just a mild scalp laceration to a devastating intracranial brain damage with either an extradural hematoma or a sub-dural hematoma. There may also be no features in the CT Scan where it will be reported as a Negative CT Scan compared to one that has pathology which will be reported as a Positive CT Scan[58]. Features in adults and children may be similar but there are variations.

Skull fractures are relatively common findings in head injury and they can be linear or depressed skull fractures[54]. In a study of CT Scan features of head injury in Ghanaian Children, fractures were commonest 73.68%, Intracranial hemorrhage 47.37% [59]. Muyembe et al found scalp wounds 52.6% and skull fractures 47.9% being the commonest in a study of head injuries at provincial General Hospital, Nyeri, Kenya[60].

Intracranial hematomas include extradural hematoma, Sub-Dural hematoma and traumatic intraventricular and sub-arachnoid hemorrhages. They occur at different incidences in various degrees of head injuries and Aggrawal et al in a study of 334 adult patients, found cerebral contusion to constitute 21.6%, extradural hematoma 20.9%. Elias GD in a prospective study of 495 patients at Moi Teaching and Referral Hospital, Eldoret, Kenya found Intracranial Hemorrhage as the leading at 17.8%[61]. Asaleye *et al* found 42% had skull fractures, 14% had extradural hematomas, 36% had subdural hematomas and 4% had subarachnoid hemorrhage[48].Epidural haemorrhage either alone or in combination with another type of haemorrhage was noted in 77.7% in a study by Saurabh et al 2010[62]. Gan et al also showed a higher incidence of mass lesions (extradural Hematoma, Subdural Hematoma) and traumatic subarachnoid hemorrhage[63].

Open fontanelle and sutures predispose a child to a higher incidence of subdural hernatoma (SDH). A possible explanation may be that in a skull that can expand, a clinically significant volume of blood can easily get accumulated. Absence of arachnoid adhesions and pachionian granulations, predispose to tearing of bridging veins and accumulation of blood along the vertex[34]. Intraventricular hemorrhage can occur and it is where bleeding occurs in the ventricular system of the brain but it is less common and Ojo et al found 9% had intraventricular hemorrhage. Cerebral contusion may also be seen and this involves the brain tissue undergoing trauma that causes shearing of a significant part of the brain and may be associated with intracerebral bleed. A study in Aligarh India showed 56.1% had contusion[58] and 21.6% had contusion in a study in Eastern Nepal[1].

2.6 Pathophysiology of Head Injury

Head injury constitutes a complex chain of events from the time of onset to the time of developing pathology. Primary head injury occurs immediately at the time of impact and causes damage to the brain or a lesion that is irreversible. This can cause the patient to have different degrees of levels of consciousness and are classified according to Glasgow Coma Scale[64] described by Teasdale et al in 1974.

Secondary brain injury occurs as a result of subsequent brain edema around the primary lesion, increased intracranial pressure and ischemia which leads to various parts of the brain being affected. These secondary changes can cause tonsillar herniation through foramen magnum due to the increased intracranial pressure and may eventually lead to death of the patient. These secondary injuries from traumatic brain injury lead to alterations in cell function and propagation of injury through processes such as depolarization, excitotoxicity, disruption of calcium homeostasis, free-radical generation, blood-brain barrier disruption, ischemic injury, edema formation, and intracranial hypertension[65].

The Imbalance between cellular production of free radicals and the ability of cells to defend against them called oxidative stress (OS) has been implicated as a potential contributor to the pathogenesis of acute central nervous system (CNS) injury. After brain injury by ischemic or hemorrhagic stroke or trauma, the production of reactive oxygen species (ROS) may increase, sometimes drastically, leading to tissue damage via several different cellular molecular pathways[66].

Studies have indicated that reactive oxygen/nitrogen species are readily generated in vivo, playing roles in the pathophysiology of secondary brain injury by oxidatively modifying various proteins. It is thought that large conductance Ca2-activated K channels (BKca or Slo) are subject to redox regulation and Radicals generated as a result of brain injury cause damage to cardinal cellular components such as lipids, proteins, and nucleic acids (e.g., DNA), leading to subsequent cell death by modes of necrosis or apoptosis[67].

The damage can become more widespread due to weakened cellular antioxidant defense systems. Moreover, acute brain injury increases the levels of excitotoxic amino acids (such as glutamate), which also produce Reactive Oxygen Species, thereby promoting parenchymatous destruction[66].

Neuronal death after ischemic or traumatic injury is mediated, in large part, by excitotoxicity. Originally, it was thought that cell damage by ischemia/reperfusion and other forms of neuronal insults was caused by calcium-mediated activation of phospholipases and proteases, leading to release of free fatty acids and their metabolites, the concomitant generation of reactive oxygen species, and the degradation of cytoskeletal proteins it is now clear that an important coupling exists between glutamate release, calcium influx, and enhanced production of reactive oxygen species, such as superoxide anion, hydrogen peroxide, hydroxyl radical, and nitric oxide (NO)[68].

Infarction of any part of the brain will result in development of residual focal neurological deficits in the various parts of the body e.g. upper limb, or lower limb and this may be a permanent change causing impairment in the normal functioning of the person in the day to day activities.

2.7 Diagnosing Head Injury

Diagnosis of Head Injury historically involved use of plain Skull Radiographs[8]. This involved taking of Antero-posterior and Lateral Views of the Skull and looking at the position of the calcified pineal gland which if it was deviated more than 3mm to any side, it indicated pathology on the side opposite that which it is deviated to. but with advancing technology, CT Scanning, which evaluates the skull structures non-invasively, is the procedure of choice for diagnosis, evaluation and determination of the prognosis of patients with acute head trauma[13,69,70]. Axial non-contrast CT Scanning is the gold standard technique spanning the base of the occiput to the vertex in 5 mm increments. CT with brain tissue windows (WW 150-200 HU, WL 25-30) and Bone Windows (1600-4000HU, WL 250-400HU) is necessary to rule out small hematomas and skull fractures respectively. Subdural window is also required to demonstrate intracranial hemorrhage better[71,16](See Appendix III).

After the first use of CT in 1978, the usage of skull X-Ray, angiography and surgical intervention in diagnosing head injuries have been reduced by 24%, 84% and 58% respectively[13]. Axial CT Scan with high resolution scanners provides images with excellent details that are sufficient in emergencies and results analyzed within 1hr for better patient management[72].

While MRI is more sensitive and accurate for diagnosing cerebral pathology, CT is the most critical imaging technique for management of head injured patients in the acute stage[71,70].

In patients with minor head injury, several criteria have been developed to address indications for head CT scanning but a significant number of these patients have still been found to have features despite the minor head injury[37.]

The Glasgow Coma Scale introduced by Teasdale and Jennet in 1974, was devised to provide uniform approach to the clinical assessment of patients with acute head trauma. It measures levels of arousal and awareness and attempts to assign numerical values (1-4) to eye opening, best motor response and best verbal response. Scores of 13-15 correspond to mild head injury, 9-12, moderate head injury and 8 or lower, severe head injury[64,5,73]

New Orleans criteria recommend CT if a patient has any of the following: headache, age greater than 60 years, drug or alcohol intoxication, deficits in short term memory, seizure, or evidence of injury above the clavicles. Other criteria for doing a head CT Scan in mild head injury include Canadian Head CT Rule which has five factors which are, a score lower than a perfect 15 on the Glasgow Coma Scale 2 hrs after the injury, a suspected open or depressed skull fracture, more than 2 episodes of vomiting, physical evidence of basal skull fracture and age greater than 65 yrs[54,69].

2.8 Prognosis of patients with Head Injury

Prognosis of patients with head injury depends on the nature of the head injury, cause, age of the patient and the duration of intervention and access to medical care. It has been shown that the longer the duration before reaching hospital, the worse the prognosis due to setting in of more brain damage from causes of secondary brain injury including edema and increased intracranial pressure[52].

Elderly patients have a poorer outcome when they have head injury and according to BK Gan et al 2004, the elderly group had mortality 55.4% slightly more than double the younger group at 20.9%[63]. Mortality has also been found to be significantly associated with extremes of age, presence of pre-morbid illness e.g. coagulation disorders, previous head trauma and other associated injuries e.g. chest injury, or abdominal injury[1,6,11] and children were also found more likely to die before arrival in hospital than adults[52].

Children younger than 4 years of age have been reported to have poor prognosis similar to the elderly while better outcomes have been reported in 5 to 15 year age group[34]. The level of Glasgow Coma Scale also determines the prognosis of the patient. GCS score of more than 13 may indicate good prognosis while less than 8, worse prognosis. A study in Saudi Arabia found that patients with GCS score of more than 12 could have potentially serious intracranial pathology and GCS score of less than 12 was an important predictor for death, and intracranial edema being the commonest finding[53].

Chapter 3: METHODOLOGY

3.1 Study site

This was done at The Moi Teaching and Referral Hospital, Eldoret Kenya. The hospital serves the North Rift, Nyanza and western Provinces in Kenya, Eastern Uganda and South Sudan. It also serves as a referral hospital for the neighboring health facilities. The large catchment population offered an appropriate site to undertake the study.

3.2 Study Design

The study was a cross-sectional survey.

3.3 Study population

The study population was Patients with all kinds of head injury seen at MTRH.

3.4 Sampling Technique

Sampling was done by Consecutive sampling. Every patient with head injury who presented was consecutively sampled and interviewed after obtaining informed consent. The patient was informed about the nature and purpose of the study and the inclusion into the study. This was continued until the desired number was reached. The patients who were conscious and able to give consent, gave consent, for those who were unconscious, consent was sought from the relative who cared for the patient and for the children, their parents or guardians (see Appendix I). Study subjects were recruited based on inclusion and exclusion criteria and those satisfying the inclusion criteria were included as per the criteria (outlined below). The study was undertaken from unselected patient population but it did not involve treatment and follow up.

Patient details were noted down in the form i.e. age, gender, date, and the cause of the head injury (see appendix II for details).

The GCS score of the patient was also recorded. The CT scan patterns in the findings were recorded in the respective part of the form.

3.4.1 Inclusion criteria

a. Patient with head injury done CT Scan head.

3.4.2 Exclusion criteria

a. CT Scan head for other illnesses e.g. CerebroVascular Accidents (CVA).

b. Patient found unconscious with no clear history of head injury.

3.4.3 Sample size

The sample size was determined using Fischer *et al* (1998) Formula as shown below:

$$n = \left(\frac{Z_{1-\alpha/2}}{\delta} \right)^2 P(1 - P)$$

Where

n = sample size; Z =1.96, the coefficient value corresponding to 95% confidence; α = significance level (5%); p = estimated prevalence; d = precision/margin of error

Based on a study by Mebhratu et al on The Profile of CT Scan Findings in patients with Acute Head Trauma in Orotta Hospital, Asmara Eritrea, the commonest intracranial CT Scan finding was Intracerebral Hematoma 20%, and based on this incidence using the above formula the sample size is 241 patients.

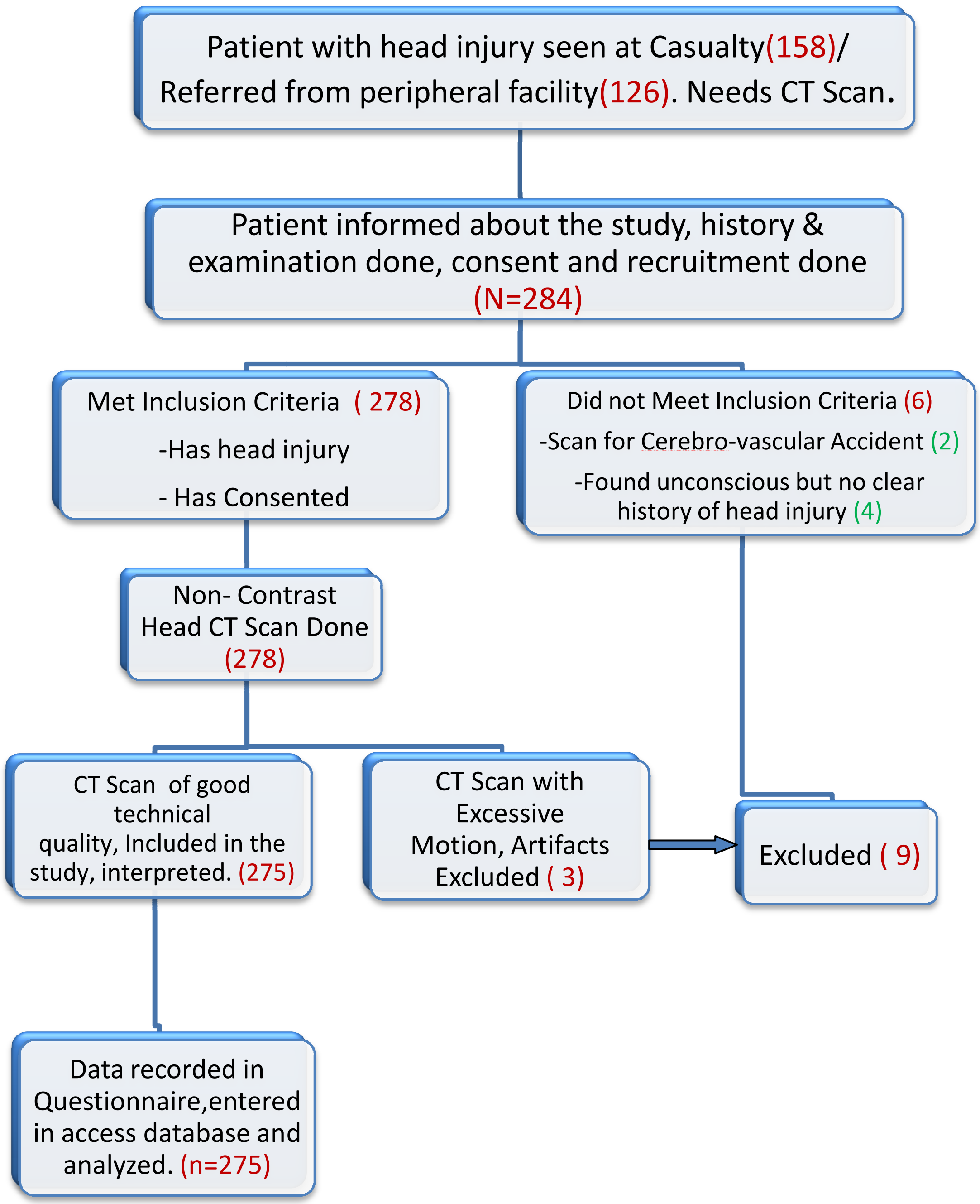
3.5 Procedures

The Procedure performed on the patients was a Non-Contrast Head CT Scan.

Patient monitoring during the scanning was done to note any change in the level of consciousness where necessary interventions were done.

This procedure is detailed in appendix III.

3.6 Study Flow Chart/Recruitment Schema.



3.7 Quality control

All head CT scans were done at MTRH CT SCAN room that has internal quality controls. These are done as when the patient is sent for the scan; either as emergency or follow up as per protocol.

The scans were read by the registrar (Investigator) doing the study and by two qualified radiologists to correlate the findings. The Two radiologists, who were the same all through the study, independently viewed the films and where they agreed a radiological diagnosis was made, in case of disagreement, consultations were made and a consensus made.

3.8 Data collection and management

Data was collected on a structured interviewer administered questionnaire and later transferred to a computer database; double entry was used to ensure accuracy of the data. Coding of the data was done thereafter. All patient details were kept confidential and data was only available to the investigator and the supervisors via password protection. Patients were given a copy of their results and had autonomy over who else could view their scan result(s).

Data was analyzed using Stata Statistical Package version 11.

3.9 Ethical considerations

Approval to carry out the study was sought from the Institutional Research and Ethics Committee (IREC). Informed consent was obtained from all patients and they were informed about the study using their head CT scan films, and how the investigator would go about interpreting the findings and patterns. They were informed about the procedures involved in the study and the possible benefits and harm to them, the patient was informed that the procedure was generally safe but had potential risks. Regarding the necessity of the investigation for management of the patient, consent was sought from the hospital management and IREC to allow studying of the scans of the patients who had undergone scanning. All patient records were kept confidential and all patients received medical attention as necessary regardless of their willingness/unwillingness to participate in the study. No incentives or inducements were used to convince patients to participate in the study. Patients were informed of their results and appropriate standard treatment given. A mechanism was put in place to ensure that results were made available to the clinicians who routinely took care of the patients who participated in this study.

CHAPTER 4: RESULTS

A total of 275 patients were seen during the study period and included in the study. There were 240 males (87.3%) and 35 females(12.7%), and male to female ratio of 6.8:1. Their ages ranged from 2 months to 90yrs with a mean of 32.91 yrs. Most patients were not referred 155(56.4%) though a significant number of patients were referred 120(43.6%).

Majority of the patients had mild head injury 145(52.73%), those with moderate head injury 75(27.27%) and those with severe injuries were 55(20%). This was assessed using the Glasgow Coma Scale (GCS). The children under 5yrs were 7(2.55%).

Table 1: Causes of Head Injury

Cause	Frequency	Percentage
Assault	114	41.5
Vehicle	81	29.5
Fall	35	12.7
Motorcycle	34	12.4
Other	9	3.3
Bicycle	2	0.7
Total	275	100

The most common cause of head injury was assault accounting for 114(41.5%) patients. The second commonest cause was motor vehicle accidents 81(29.5%) patients then followed by Falls 35(12.7%) patients.

Motorcycle accidents accounted for 34(12.4%) and this involved mostly passengers who didn’t wear helmets. Bicycle injuries were the least 2(0.7%).

Others were 9(3.3%) and this included being hit by falling objects.

The causes above were represented graphically as shown in figure 2 below.

Figure 2: Causes of head Injury.

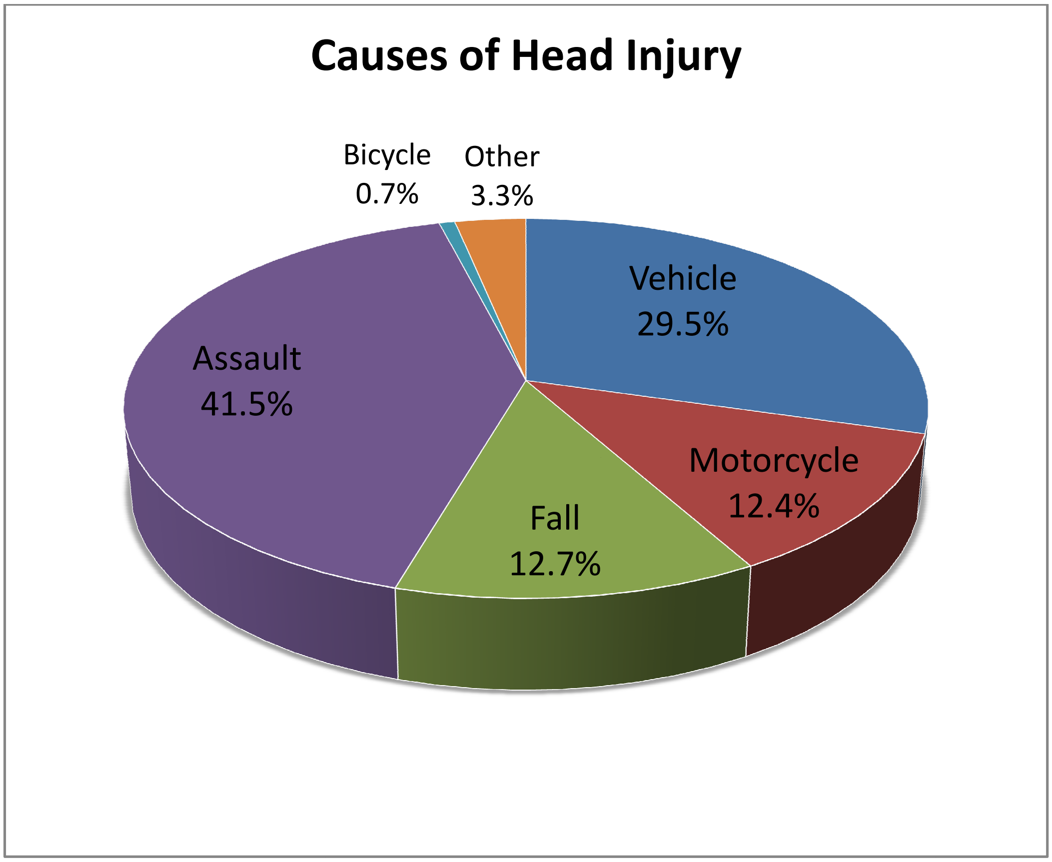
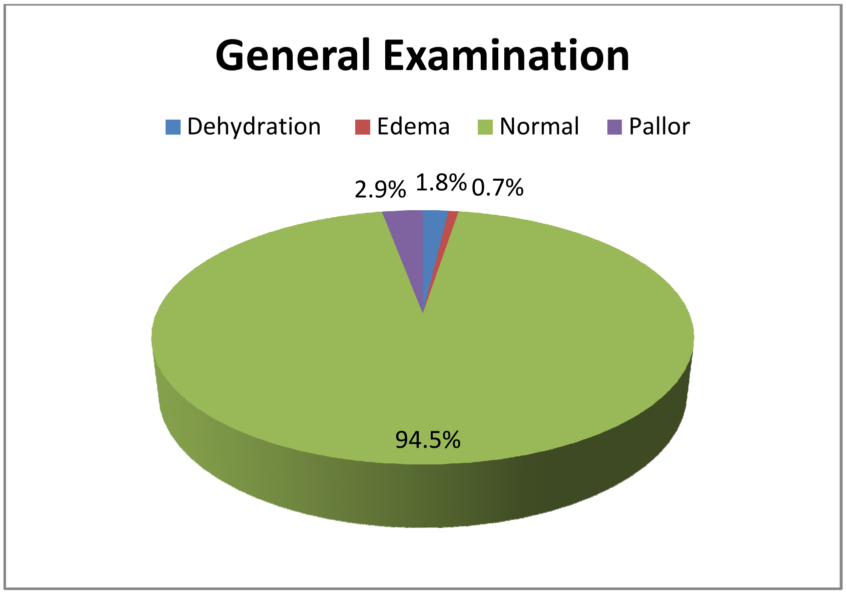


Figure 3: General Examination.

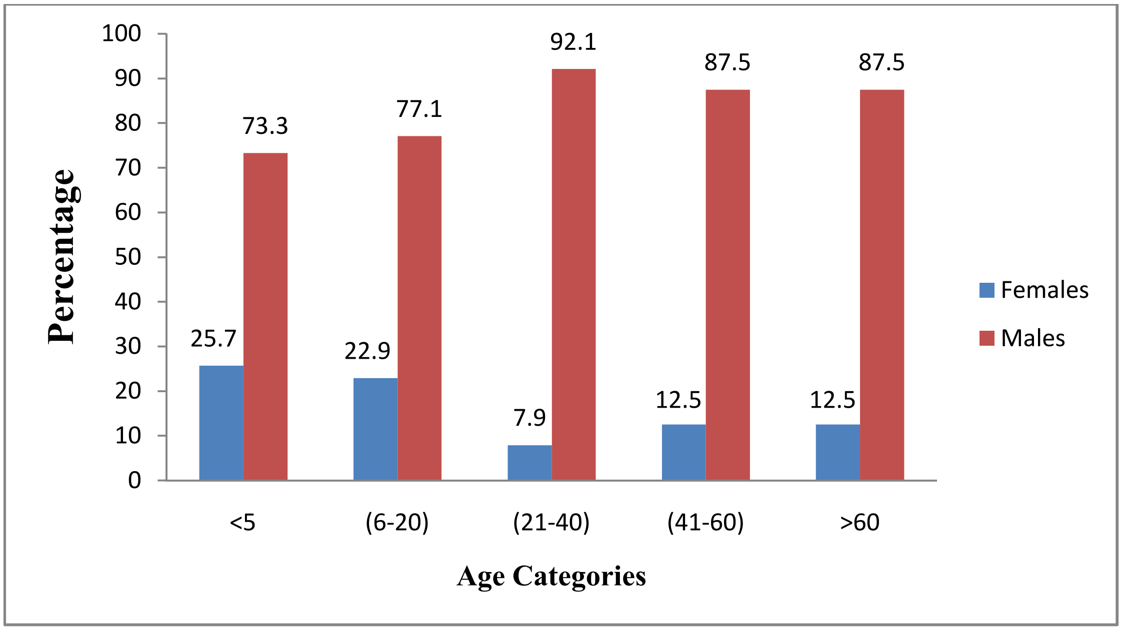


Most patients had normal general examination 260(94.5%), pallor 8(2.9%), Edema 2(0.7%), and dehydration 5(1.8%).

The central nervous system was the most involved system with 127(46.2%) being abnormal and 148(53.8%) being normal. The cardiovascular, abdominal and respiratory systems were very minimally involved. Musculoskeletal injuries were also noted to be relatively common with injuries involving motor vehicle and motorcycle accidents.

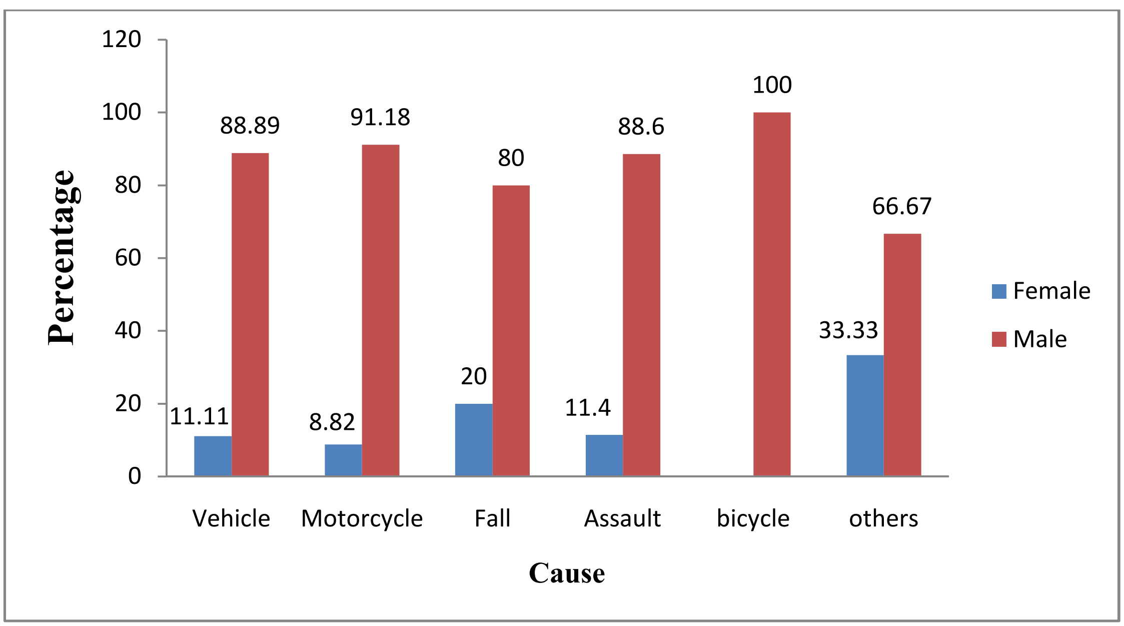
The mean weight was 50.62kgs, pulse 88.70bpm, temp 36.87^{o}C and SPO_2 93.84%.

Figure 4: Age and Gender Distribution



The above figure 4 shows age and gender distribution of the patients and it shows that majority were males compared to the females and those aged 21-40yrs were the majority. The least involved group was the under 5 year olds and males were also more than females.

Figure 5: Cause and Gender Distribution



The above figure 5 shows that majority of the patients involved were males in all the causes of head injury and no female was involved in bicycle accident where only males were involved.

Table 2: Severity versus cause, age and gender

	Mild	Moderate	Severe	Chi-square p-value
Causes				
Vehicle	41 (50.61)	23 (28.40)	17 (20.99)	
Motorcycle	18 (52.94)	10 (29.41)	6 (17.65)	0.610
Fall	17 (48.57)	11 (31.43)	7 (20.00)	
Assault	62 (54.39)	28 (24.56)	24 (21.05)	
Bicycle	0	2 (100)	0	
Other	7 (77.78)	1 (11.11)	1 (11.11)	
Age in Yrs categories				
<5	4(57.14)	1(14.29)	2(28.57)	
6-20	31 (55.36)	12 (21.43)	13 (23.21)	0.0001
21-40	72 (51.43)	45 (32.14)	23 (16.43)	
41-60	28 (58.33)	11 (22.92)	9 (18.75)	
>60	10 (41.67)	6 (25.00)	8 (33.33)	
Gender				
Male	132(55.00)	65 (27.08)	43 (17.92)	0.098
Female	13 (37.14)	10 (28.57)	12 (34.29)	

Table 3 above shows that in patients who were involved in motor vehicle accidents, majority 41(50.61%) had mild head injury. 17(48.57%) of those due to falls had mild head injury and 7(20%) had severe injury. The severity in relation to cause was shown not to be statistically significant with a *p*-value of 0.610. Severity compared to age showed that the young and the elderly have a significant relation with worsening severity in the age groups when they have head injuries compared to the middle age groups with a p-value of 0.0001. There was no variation with gender in terms of severity with both male and females being involved in a similar pattern with the p value being 0.098.

Figure 6: Percentage for the CT findings

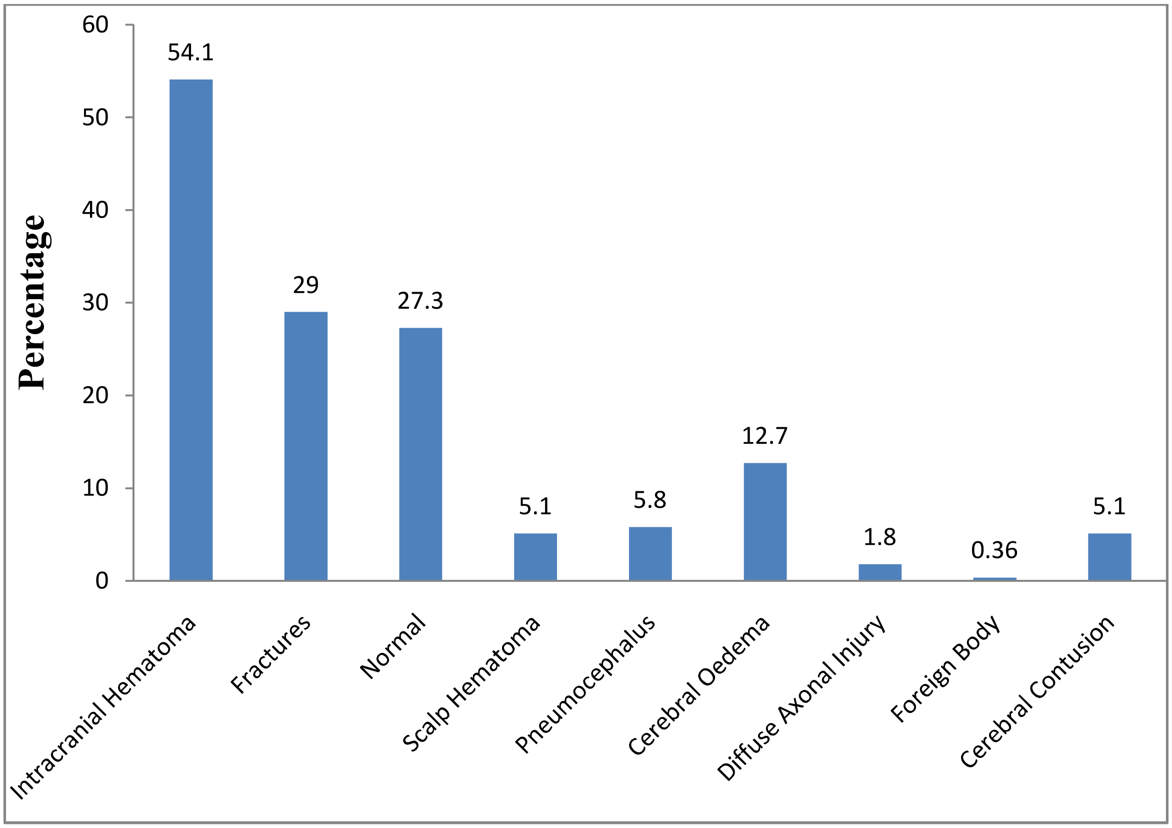


Figure 6 above shows that the most common CT finding was intracranial hematomas 54.1% followed by skull fractures 29%. Patients with normal scan comprised 27.3%. A significant number of patients had cerebral edema 12.7% and those with Pneumocephalus were 5.8%. Scalp Hematoma accounted for 5.1% and Foreign body 0.36%. Cerebral contusion was 5.1%. Diffuse axonal injury accounted for 1.8%.

Figure 7: Percentage (sub) for the intracranial hematoma CT findings

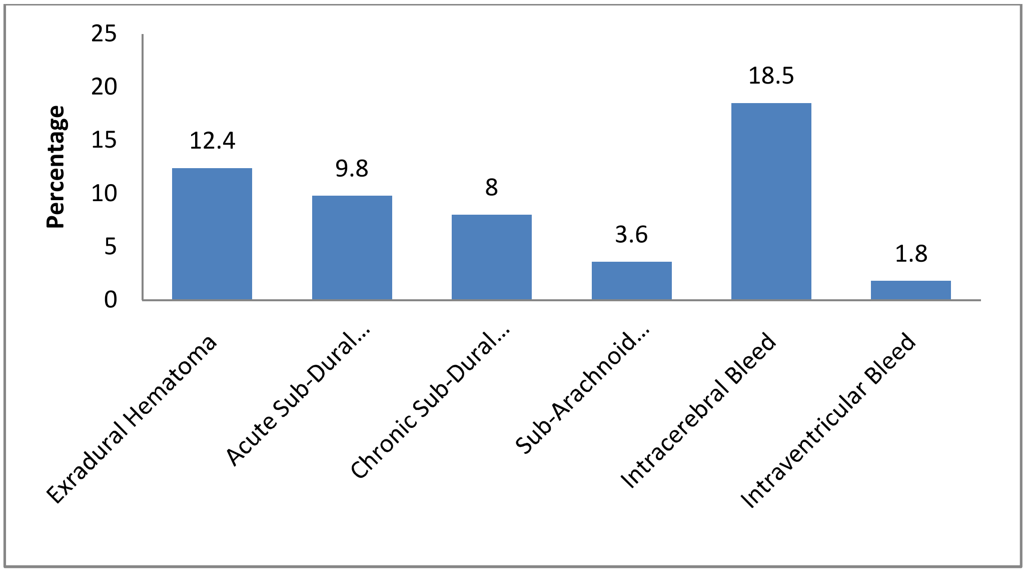


Figure 7 above shows that the most common of the intracranial hematomas was Intracerebral bleed 18.5% followed by Extradural hematoma 12.4%. Acute Sub-Dural hematoma was third 9.8% then chronic sub-dural hematoma 8%. Intraventricular bleed was the least 1.8%.

Figure 8: Percentage (sub) for the skull fracture CT findings

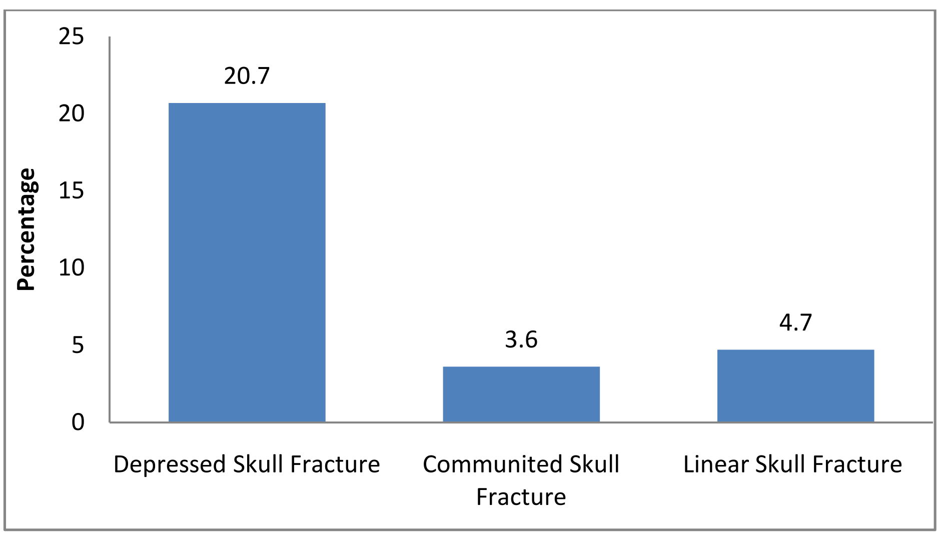


Figure 8 above shows that Depressed skull fracture was the commonest finding 20.7% among the skull fractures followed by linear skull fractures 4.7% and comminuted skull fracture 3.6%.

Table 3: CT findings by cause: Normal and Abnormal scans.

Cause	Abnormal	Normal
Vehicle	42 (51.85)	39 (48.15)
Motorcycle	28 (82.35)	6 (17.65)
Fall	28 (80.00)	7 (20.00)
Assault	94 (82.46)	20 (17.54)
Bicycle	2 (100)	0
Other	6 (66.67)	2 (33.33)
Total	200(72.7%)	75(27.3%)

Table 3 above shows that most patients had abnormal scans 72.7% (200) compared to those who had normal scans 27.3% (75). In pts who had motor vehicle accident 42(51.85%) had abnormal scans while 39(48.15%) had normal scan. Those who were assaulted 94(82.46%) had abnormal scan while 20(17.54%) had normal scans.

A logistic regression model was fitted to assess whether the CT finding were associated with the cause and the results are shown below. From the table 4 below, we observe that those who had a vehicle accident were more likely to have a normal CT scan compared to the other causes since the odds ratios are all below 1.

Table 4: Logistic regression: odds ratio

Normal	Odds ratio	95% Confidence Interval	
Motorcycle vs Vehicle	0.231	0.086	0.617
Fall vs Vehicle	0.269	0.106	0.686
Assault vs Vehicle	0.229	0.120	0.439
Other vs Vehicle	0.538	0.126	2.302

Table 5: CT findings distribution by cause

CT FINDINGS	CAUSE					
	Vehicle	**Motorcycle**	**Fall**	**Assault**	**bicycle**	**others**
EXTRADURAL HEMATOMA	10(29.4%)	1(2.9%)	4(11.8%)	19(55.9%)	0(0%)	0(0%)
ACUTE SUB-DURAL HEMATOMA	2(7.4%)	5(18.5%)	7(25.9%)	11(40.7%)	0(0%)	2(7.4%)
CHRONIC SUB-DURAL HEMATOMA	4(18.2%)	2(9.1%)	12(54.5%)	2(9.1%)	1(4.5%)	1(4.5%)
NORMAL	39(52%)	6(8%)	7(9.3%)	20(26.7%)	0(0%)	3(4%)
SCALP HEMATOMA	3(21.4%)	0(0%)	0(0%)	10(71.4%)	0(0%)	1(7.1%)
LINEAR SKULL FRACTURE	7(53.8%)	2(15.4%)	1(7.7%)	3(23.1%)	0(0%)	0(0%)
COMMINUTED SKULL FRACTURE	2(20%)	0(0%)	0(0%)	8(80%)	0(0%)	0(0%)
DEPRESSED SKULL	4(7%)	6(10.5%)	2(3.5%)	43(75.4%)	1(1.8%)	1(1.8%)
SUBARACHNOID HEMORRHAGE	2(20%)	4(40%)	1(10%)	3(30%)	0(0%)	0(0%)
CEREBRAL EDEMA	7(20%)	8(22.9%)	4(11.4%)	15(42.9%)	0(0%)	1(2.9%)
FOREIGN BODY	0	0	0	1 (100)	0	0
INTRACEREBRAL BLEED	17(33.3%)	6(11.8%)	4(7.8%)	22(43.1%)	1(2%)	1(2%)
INTRAVENTRICULAR BLEED	2(40%)	1(20%)	0(0%)	2(40%)	0(0%)	0(0%)
DIFFUSE AXONAL INJURY	1(20%)	2(40%)	0(0%)	2(40%)	0(0%)	0(0%)
PNEUMOCEPHALUS	4(25%)	2(12.5%)	0(0%)	8(50%)	0(0%)	2(12.5%)
CEREBRAL CONTUSION	6(42.9%)	1(7.1%)	0(0%)	6(42.9%)	0(0%)	1(7.1%)
TOTAL	81(29.5%)	34(12.4%)	35(12.7%)	114(41.5%)	2(0.7%)	9(3.3%)

The above table 5 shows that Assault was the leading cause of extradural hematomas with 19(55.9%) followed by motor vehicle accidents 10(29.4%). Most patients with acute sub-dural hematomas were also as a result of assault 11(40.7%). Chronic subdural hematoma was seen mostly in falls 12(54.5%).Most normal scans were seen in patients who had motor vehicle accidents 39(52%) compared to assaults 20(26.7%).Depressed skull fracture was commonly following assault 43(75.4%) while linear skull fracture was mostly following motor vehicle accidents 7(53.8%). Sub arachnoid hemorrhage was common following motorcycle accidents (40%).

Table 6: CT findings distribution by age

CT FINDINGS	Age				
	<5(child)	**6-20**	**21-40**	**41-60**	**>60**
EXTRADURAL HEMATOMA	0(0%)	8(23.5%)	18(52.9%)	7(20.6%)	1(2.9%)
ACUTE SUB-DURAL HEMATOMA	1(3.7%)	1(3.7%)	17(63%)	4(14.8%)	4(14.8%)
CHRONIC SUB-DURAL HEMATOMA	1(4.5%)	0(0%)	4(18.2%)	4(18.2%)	13(59.1%)
NORMAL	4(5.3%)	21(28%)	41(54.7%)	7(9.3%)	2(2.7%)
SCALP HEMATOMA	1(7.1%)	2(14.3%)	8(57.1%)	3(21.4%)	0(0%)
LINEAR SKULL FRACTURE	3(23.1%)	3(23.1%)	5(38.5%)	2(15.4%)	0(0%)
COMMINUTED SKULL FRACTURE	1(10%)	3(30%)	5(50%)	1(10%)	0(0%)
DEPRESSED SKULL	1(1.8%)	9(15.8%)	31(54.4%)	15(26.3%)	1(1.8%)
SUBARACHNOID HEMORRHAGE	0(0%)	1(10%)	4(40%)	3(30%)	2(20%)
CEREBRAL EDEMA	2(5.7%)	8(22.9%)	17(48.6%)	7(20%)	1(2.9%)
FOREIGN BODY	0(0%)	0(0%)	1(100%)	0(0%)	0(0%)
INTRACEREBRAL BLEED	2(3.9%)	8(15.7%)	29(56.9%)	8(15.7%)	4(7.8%)
INTRAVENTRICULAR BLEED	0(0%)	2(40%)	1(20%)	2(40%)	0(0%)
DIFFUSE AXONAL INJURY	0(0%)	2(40%)	2(40%)	1(20%)	0(0%)
PNEUMOCEPHALUS	0(0%)	1(6.3%)	11(68.8%)	3(18.8%)	1(6.3%)
CEREBRAL CONTUSION	1(7.1%)	3(21.4%)	9(64.3%)	0(0%)	1(7.1%)
TOTAL	15(5.5%)	48(17.5%)	140(50.9%)	48(17.5%)	24(8.7%)

Table 6 above shows that Most patients with extradural hematoma were aged between 21-40 yrs 18(52.9%) while chronic subdural hematoma was mostly seen in elderly patients >60 yrs 13(59.1%).Acute subdural hematoma was mostly seen in patients aged between 21-40 yrs 17(63%). Majority of the patients aged 21-40 yrs had normal scans 41(54.7%) as was also evident in patients with depressed skull fracture who were the majority 31(54.4%).Linear skull fracture was the commonest CT finding in children under 5 yrs of age 3(23.1%).

Table 7: CT findings distribution by gender

CT FINDINGS	Gender	
	Female	Male
EXTRADURAL HEMATOMA	3(8.8%)	31(91.2%)
ACUTE SUB-DURAL HEMATOMA	4(14.8%)	23(85.2%)
CHRONIC SUB-DURAL HEMATOMA	2(9.1%)	20(90.9%)
NORMAL	11(14.7%)	64(85.3%)
SCALP HEMATOMA	2(14.3%)	12(85.7%)
LINEAR SKULL FRACTURE	2(15.4%)	11(84.6%)
COMMINUTED SKULL FRACTURE	1(10%)	9(90%)
DEPRESSED SKULL	5(8.8%)	52(91.2%)
SUBARACHNOID HEMORRHAGE	2(20%)	8(80%)
CEREBRAL EDEMA	4(11.4%)	31(88.6%)
FOREIGN BODY	0(0%)	1(100%)
INTRACEREBRAL BLEED	6(11.8%)	45(88.2%)
INTRAVENTRICULAR BLEED	1(20%)	4(80%)
DIFFUSE AXONAL INJURY	2(40%)	3(60%)
PNEUMOCEPHALUS	2(12.5%)	14(87.5%)
CEREBRAL CONTUSION	0(0%)	14(100%)
TOTAL	35(12.7%)	240(87.3%)

The above Table 7 shows that most CT Findings were found among the males compared to the females and males were 240(87.3%) and females 35(12.7%). Extradural hematomas were more in males 31(91.2%) compared to females 3(8.8%). Depressed skull fracture in males was 23(85.2%) and females had 4(14.8%). The normal scans were 64(85.3%) in the males and 11(14.7% in the females

‘;

.

Figure 9: Normal CT Scan

Figure 9 above shows a normal CT Scan of the brain at the level of the frontal horns of the lateral ventricles. A normal intracranial calcification of the right choroid plexus in the atrium of the right lateral ventricle is present.

Figure 10: Extradural Hematoma

Figure 10 above shows a biconvex hyperdense lesion in the right frontal region with compression of the adjacent brain parenchyma. This was an acute extradural hematoma.

Figure 11: Acute Sub-dural hematoma

The figure 11 above shows a crescentic hyperdense lesion in the left frontoparietal region with midline shift to the right. This was an acute sub-dural hematoma. There is an associated scalp hematoma.

Figure 12: Chronic Sub-dural hematoma

The figure 12 above shows a crescentic left fronto-parieto-occipital hypodense lesion with compression of the adjacent brain parenchyma. This was a chronic sub-dural hematoma.

Figure 13: Intracerebral Bleed

Figure 13 above shows a hyperdense lesion in the left basal ganglia region with compression of the ipsilateral frontal horn of the lateral ventricle. There is also surrounding cerebral edema. This was an intracerebral bleed.

Figure 14: Depressed Skull Fracture

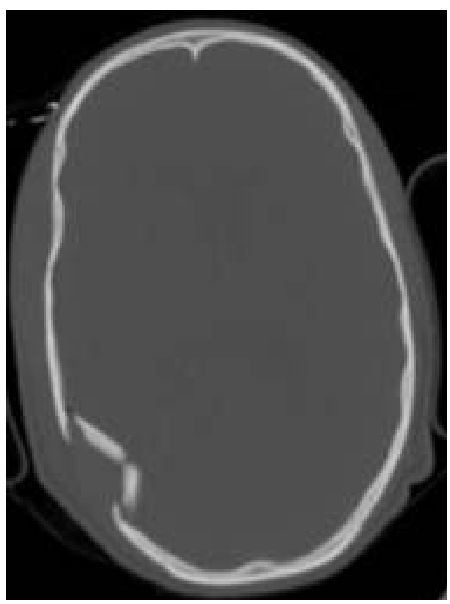


Figure 14 above with bone window settings shows a depressed comminuted skull fracture in the right parieto-occipital region post trauma. The fragments are displaced intracranially below the inner table of the skull.

Figure 15: Linear Skull Fracture

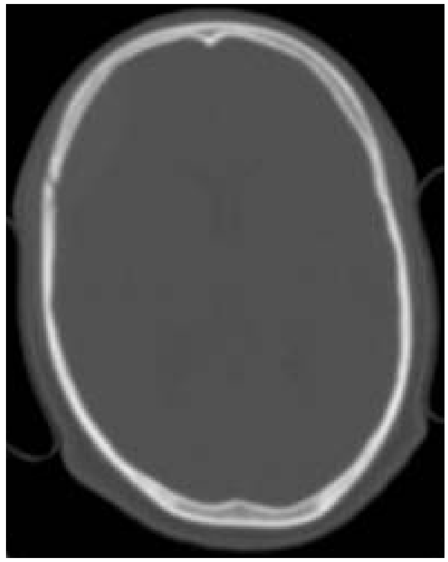


Figure 15 above shows a linear discontinuity of the skull bone in the right fronto-parietal region. This was a linear skull fracture.

Figure 16: Pneumocephalus

Figure 16 above shows multiple hypodensities within the cranium in the right frontal and parietal regions as well as the bilateral para midline regions. This was air distributed within the cranial cavity called pneumocephalus.

CHAPTER 5: DISCUSSION

5.1 Demographic characteristics

Head injuries worldwide are an important public health problem due to the nature of injuries sustained and the long term morbidity and disability that subsequently results from the injuries[1,29]. Majority of patients in the study were young adults with males outnumbering females. 87.3 % of patients were male and 12.7% were female (male to female ratio-
6.8:1). These findings are comparable to previous studies which reported ratios of males to females to range from 3:1 to as high as 11.1:1[1,6]. The high incidence in the males is due to the nature of the risks they take and the young population is due to the active nature of the work they do. This is an important public health issue as economic loss to the families and the country is enormous. The patients who were not referred 56.4% were more than the referred 43.6% and this was likely due to the fact that the hospital is along a busy highway hence most accident victims would be brought there. The hospital also serves as a referral center and injuries that occurred far from the hospital were mainly initially handled by middle level facilities which could be lacking specialist services. The referred patients were from various regions in the North Rift, Nyanza and western Provinces in Kenya, Eastern Uganda and South Sudan.

5.2 Etiology of head injuries

Assault was the leading cause of head injury in our study at 41.5% which differs from most studies which report road traffic accidents as the leading cause of head injuries[4,24]. It accounted for 41.5% of the study population. This was similar to a study by Ogendi et el 2002 who found assault to be the leading cause at 42%[74] and Odero et al 1995 who found assault to account for 40% of the head injuries [44]. It differed from a study by Bordignon et al in Brazil where he found that interpersonal aggression accounted for 17.9% of the head injuries followed by falls 17.4%[2].. The high incidence of assaults in this study is likely due to the high incidence of interpersonal aggression in the area. Increased assault was also seen in inner Chicago and Bronx where it is economically depressed and densely populated[9] which increases the incidence of interpersonal aggression.

Motor vehicle accidents was the second leading cause of head injury accounting for 29.5% and this was different compared to studies which reported it as the leading cause[1,24]. Obajimi et al 2002 found that it accounted for 43.9% being the leading cause[59]. This may be attributed to overloading and the poor status of roads with multiple potholes, over speeding and driving while drunk. This was shown by Odero et al who found that most accidents were due to drunken driving and use of un-roadworthy vehicles and alcohol intoxication was a significant cause especially during weekends[3,7].

Falls accounted for 12.7% of the head injuries and were observed mostly in children and the elderly patients which was consistent with many studies which demonstrated the high incidence of falls especially in the children and elderly patients[2,33]. This could be attributed to children being playful, climbing heights and vulnerability among the elderly respectively. Most children in the study sustained injuries from falling from heights while the elderly were noted to sustain injuries from tripping and falling at ground level. A study at Prince Wales hospital in Hong Kong also found falls at ground level to be more common in the elderly especially more than seventy five years of age (27.8%) and from heights more in young children especially less than ten years of age (25.6%).

Motorcycle injuries were also significant in the etiology of the head injuries at 12.4% especially with the increasing use of it as a mode of transport by most of the people. The passengers were often injured from preventable head injuries due to not wearing helmets among other causes. This was similarly found in Tanzania by Chalya *et al.* where motorcycle injuries was found to be a significant cause of the head injuries and most injuries were from not wearing helmets by the passengers[11]. A factsheet by World Health organization and Ministry of Public Health and Sanitation (Kenya) 2011 showed that there was forty fold increase in motor cycle in Kenya between 2005 and 2011, mostly used as taxis (locally called Bodaboda) and this has led to increase in the incidence of head and musculoskeletal injuries sustained. Less than 3% of passengers were also noted not to wear helmets[45].

The incidence of other associated injuries was low and this included chest, abdominal, cardiovascular and musculoskeletal abnormalities. Other studies showed an increase in the soft tissue injuries and musculoskeletal fractures and this also affects the final outcome of patients during recovery[6].

Bicycle accidents were the least observed in our study at 0.7% and this was different from Mebhratu et al who found bicycle accidents to be higher at 9.1%[8]. This may be due to the nature of injuries sustained being mostly the extremities and most of the bicycles in this region are in the rural farming areas used mainly for transport to the market places away from the major highways. Other studies have also found bicycle injuries to be more common in sports involving cycling, among children who use bicycles for their plays and people who use it also for recreational cycling[28,46]

5.3 Radiologic Patterns

The most common CT finding was intracranial hematomas at 54.1%, of which intracerebral bleed 18.5% , was the commonest followed by extradural hematoma at 12.4% and this was different compared to those found by Saurabh *et al.,* 2010 where epidural haemorrhage either alone or in combination with another type of haemorrhage was noted in 77.7% of the patients[62]. This may be due to the nature of the cause of injury, the location of the trauma to the skull and/or secondary effects of the primary injury. This was similar to Gan et al 2004 study which demonstrated a higher incidence of intracranial hematomas among the study population[63]. Epidural hematoma was mostly seen in the 21-40 year age group and it accounted for 12.4% of the patients in the study. A study in Eritrea by Mebhratu et al also found epidural hematoma to comprise 18.2% of the study population[8].

Depressed skull fractures were the leading among the skull fractures at 20.7% and assault was the leading cause of the depressed skull fractures. This was similar to findings by Asaleye et al 2005 who found depressed skull fractures (42.5%) being common among the study population[48]. This has been attributed to the thickness of the cranium being not uniform all throughout as there are thin plates of bones such as the frontal and temporal plates and the thickness is greater along the suture[62]. This finding is similar to a study by Muyembe *et al* 1999 which found scalp wounds and depressed skull fractures being the commonest[60]. Linear skull fractures were seen mostly in the young population and children who were under five year. This could be due to the developing skull among the under five year old children where sutures are not yet fused. In our series, 72.7% of the patients presented with positive CT findings related to acute trauma. The incidence was more compared to studies done in Orotta, Eritrea[8] where 54.5% had positive CT Findings but slightly less compared to that done in Nigeria[48] where 87% had Positive CT Findings. Patients who had normal scans were 27.3%

of the study population and they were mostly due to motor vehicle injuries. This is was similar to a study done in Bugando Tanzania where 26.2% of patients had normal scans[6]. These CT Findings vary in various populations due to the differences in the population sample size, geographical location and cultural practices which may influence the nature of the head injuries.

Acute Sub-dural hematoma accounted for 9.8% of the study population and most were also found to be due to assault and falls being more than those due to motorcycle or motor vehicle injuries. Most of the patients were in the active age group 21-40yrs and this was likely due to their occupation and economic activities among this age group. Aggrawal et al found Acute Sub-Dural Hematoma to be at 2.1% and most of the patients were in the 21-30 yr old age group[1]. Chronic Sub-dural hematomas were mostly seen in the elderly patients (>60 yrs) and this was mostly due to falls. This compares to previous studies which showed that there was increased rate of falls among the elderly with increasing incidence of chronic sub-dural hematomas. A study in Brazil by Bordignon *et al 2002*, found falls to constitute 17.4% of all head injuries[2]. Most were also associated with alcohol abuse in the elderly[2]. However other causes have been found to include ageing, weakness and frailty of the musculoskeletal system making them prone to falls[63]. The increase in Chronic Sub-dural hematomas in the elderly has been attributed to Cerebral atrophy which creates a greater potential volume of the sub-dural space with a change in mechanical properties of the bridging veins making them prone to bleeding into the sub-dural space with minimal trauma[63].

A significant number of patients (12.7%) had cerebral edema and this resulted in increased intracranial pressure worsening the level of consciousness of the patients. This was observed from their Glasgow Coma Scale which was mainly below 8/15. This was similarly demonstrated by previous studies which showed that the findings of intracranial pathology were associated with the period of loss of consciousness mainly due to the cerebral edema, being worse the longer the period of loss of consciousness[55,56].

Historically imaging of the head-injured patient relied on skull radiographs but studies have shown that the use of skull radiographs in evaluation of patients with head injury may miss a significant number of intracranial lesions and thus CT Scanning has become the diagnostic study of choice[15,16]. In the present study, CT scan was utilized in demonstrating the intracranial lesions.

A logistic regression model was fitted to assess whether the CT finding were associated with the cause and it was observed that those who had a vehicle accident were more likely to have a normal CT scan compared to the other causes since the odd ratios were all less than one. This could be due to the protective nature of the car having air bags, protective cage/body of the car and seatbelts. This is in contrast to motorcycle or assaults which are more exposing to the injury. These findings were different compared to previous studies which showed that the patients involved in motor vehicle injuries sustained more injuries and had a higher chance of having intracranial pathology[12,18].

5.4 Association between Severity of head injury and cause, age and gender

The level of severity among the patients who were in the extremes of age (very young and in the elderly) was noted to be worse compared to the middle aged patients and was found to be significant with a p-value of 0.0001. This was comparable to previous studies which showed that the very elderly and very young patients when they get head injury, they have more severe head injuries with lower Glasgow coma scale[53,55]. This may be attributed to the frailties of advanced age, pre-existing systemic disease, alterations in haemostatic mechanisms and change in viscoelastic properties of the brain among the elderly[63] and the developing brain in the very young which is delicate and sensitive to any insult on it giving more severe head injuries[59].

Majority of the patients had mild head injury (52.73%) and this was similar to other previous studies which showed that most of the patients with head injuries have mild head injury[30,31]. This was followed by moderate (27.27%) then severe head injury (20%).It was found that assault was the leading cause of the patients who had mild head injury as was patients involved in motor vehicle accidents. The level of severity as per the cause was found not to be significant with a p-value of 0.610 and this was similar to findings by Bajracharya *et al*[17]. This may be due to the fact that level of severity of the injury will depend on the nature of cause of injury, mechanism of injury, and impact during the time of the injury.

No gender variation was seen as regards the level of severity in relation to the cause of head injury with a p-value of 0.098 and this could be attributed to random occurrence of the injury. This was similarly shown in a study in Malaysia by Chan et al[49] in a multivariate analysis. The correlation between severity of head injury and the cause and CT findings showed a linear relationship and the more the intracranial CT Findings, the more the severity of the head injury. This may be because the more the intracranial findings detected on head CT, the more the structures involved and the worse the cerebral edema, and thus the more worse the severity of the head injury.

CHAPTER 6: CONCLUSION

Head injury remains an important public health problem accounting for a substantial proportion of all trauma admissions at The Moi Teaching and Referral Hospital, Eldoret, Kenya. Assault was the leading cause of head injury. Motor Vehicle Accidents were still a significant cause of head injuries.

The commonly affected were young adult in their productive years with males more affected compared to females. The children under 5 years and the elderly sustained head injury mostly from falling and when they had head injury, most were severe injuries.

CT Scan depicts various findings and these vary depending on the nature of the injuries sustained. Preventive measures to reduce assaults and motor vehicle accidents are necessary to reduce the incidence of head injuries in this region.

Increased public awareness and early imaging by CT aids in detection of the intracranial injuries early enough thus facilitating early treatment of the patients.

CHAPTER 7: RECOMMENDATIONS

1. Enhance the rule of law, improve community cohesiveness, tighten the society's moral fabric and moral values, and increase security to reduce incidences of assault.
2. Advocate road safety campaigns to reduce road traffic accidents. These include:
    - i) Enforce use of Helmets for motorcycles for both driver and passenger.
    - ii) Ensure use of seat belts and air bags in cars.
    - iii) Enforce the traffic laws
    - iv) Improve quality of our roads which include patching pot holes, widen roads, increase lanes and increase of road signs.
    - v) Avoid driving under influence of alcohol.
3. Equip middle level health facilities with appropriate medical diagnostic and treatment equipments including CT Scans and trauma centers so as to be able to detect and manage head injuries early.
4. Carry out more studies regarding head injury treatment outcomes and follow up of the patients to determine the survival rate and long term disability among the head injury patients.

CHAPTER 8: LIMITATIONS

1. Delayed referral of patients which meant acute findings of head injury may not be captured fully.
2. Cost of CT scan relatively expensive to a number of patients hence they opted to stay longer as they looked for the funds to do the scan especially those who were referred.
3. Limited availability of CT Scanners: Most CT Scanners are in the major towns including Eldoret, Kenya, thus limited accessibility to the CT Scanners by the majority of the population, hence leading to delay in arrival for scanning.

REFERENCES

1. Agrawal A, C.S.Agrawal, Kumar A, Lewis O, G. Malla, Chalise. P. Head Injury at a Tertiary Referral Centre in the Eastern Region of Nepal. *East and Central African Journal of Surgery.* March/April 2009; 14(1):57-63.

2. Bordignon KC, Arruda WO. CTScan findings in mild head trauma A series of 2,000 patients. *Arq Neuropsiquiat.* June 2002;60(2A São Paulo):204 – 210.

3. Odero W, Khayesi M, Heda PM. Road Traffic Injuries in Kenya: Magnitude, Causes and Status of intervention; Injury and Safety Promotion. 2003;10(1-2):53-61.

4. Odero W, Garner P, Zwi A. Road traffic injuries in developing countries: acomprehensive review of epidemiological studies. *Tropical Medicine and International Health.* 1997;2(5):445-460.

5. Porchet F. Acute Management of Mild Traumatic Brain Injury. *Scweiz. Arch. Neurol. Psychiatr.* 1998(149):68-72.

6. Chalya PL, Kanumbra ES, Mabula JB, Giiti G, Gilyoma JM. Aetiological spectrum, Injury characteristics and treatment outcome of head injury patients at Bugando Medical Centre in North - Western Tanzania. *Tanzania Journal of Health Research.* 2011;13(1):93-102.

7. Odero W. Alcohol-related road traffic injuries in Eldoret, Kenya. *East Afr Med J* 1998(75):708-771.

8. Ghebrehiwet M, Quan LH, Andebirhan T. The profile of cranial CT Scan findings in acute head trauma in Orotta Hospital, Asmara Eritrea. *Journal of Eritrea Medical Association (JEMA).* 2008:5-8.

9. Cooper K, Tabbador K, Hauser W, K S, C F, PR F. The epidemiology of head injury in theBronx. *Neuroepidemiology.* 1983(2):70-88.

10. Jennet B. Epidemiology of head injury. *Journal of Neurology, Neurosurgery, and Psychiatry.* 1996(60):362-369.

11. Chalya PL, Mabula JB, Ngayomela IH. Motorcycle injuries as an emerging public health problem in Mwanza City north-western Tanzania. *Tanzania Journal of Health Research.* 2010.

12. Thiruppathy SP, Muthukumar N. Mild Head Injury revisited 2004. *Acta Neurochir (Wien).* 2004;146:1075-1083.

13. Stevens SD, K JM. Intracranial Lesions (2). *Sutton D. Textbook of Radiology and Imaging* 2003;7th Ed(London. Churchill Livingstone):1778-1782.

14. Sun Z, K.H N, Visayanathan A. Is utilization of CT Jutified in Clinical Practice? Part 1: Application in the emergency department. *Singapore Med Jn.* 2010;1(3):200-205.

15. Haydel MJ, Preston CA, mills TJ, Luber S, Blaudeau E, Deblieux MCP. Indications for CT in patients with Minor Head Injury. *NEJM.* 2010;2000(343):100-105.

16. Mehdi S. A, Ahmed B, Dogar IH, Shaukat A. Depressed skull fracture; Interrelationship between CT Evaluation of depressed skull fracture and its clinical findings. *Professional Med J.* Dec 2010;17(4):616-622.

17. Bajracharya A, Agrawal A, BR Y, CS A, LO. Spectrum of surgical trauma and associated head injuries at a university hospital in eastern Nepal. *J Neurosci Rural Pract.*2010(1):2-8.

18. Khaji A, Eftekhar B, Karbakhsh M, Ardalan KM. Use of Head CT in Mild Head Injury. *Neurosciences 2006.* 2006;11(4):248-251.

19. Kraus J. Epidemiology of head injury. *Cooper PR, ed.* 1993(3rd ed Baltimore William Wilkins):1-25.

20. Hassan S, Macharia WM, Atinga J. Self reported alcohol use in an urban traffic trauma population in Kenya. *East Afr Med J.* 2005 Mar;82(3):144-147.

21. Otieno T, Woodfield JC, Bird P, Hill AG. Trauma in rural Kenya. *East Afr Med J.* 2004;35(12):1228-1233.

22. Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: A global perspective *NeuroRehabilitation.* 2007;22(5):342-353.

23. Farghaly A, El-Khayat R, Awad W, George S. Head Injuries in Road Traffic Accidents. *Forensic Medicine and Clinical Toxicology, and Neurosurgery Departments, Faculty of Medicine, Assiut University, Assiut, Egypt.* 2005.

24. Puvanachandra P, Hyder AA. The Burden of Traumatic Brain Injury in Asia: A Call for Research. *Pak J. Neurol Sci 2009* 2009;4(1):27-32.

25. Vinand M Nantulya MRR. The neglected epidemic: Road traffic injuries in developing countries. *BMJ.* 2002;11(324):1139-1141.

26. Smith GS BP. Unintentional injuries in developing countries: the epidemiology of a neglected problem. *Epidemiol Rev.* 1991;13:228-266.

27. Osoro ME, Zipporah Naa, Joseph O, Jared O, Elizabeth L. Factors associated with severity of road traffic injuries, Thika Kenya. *Pan African Medical Journal.* 10th Mar 2011;8(20):1-9.

28. Hsiang JNK, Cheung TKW, Goh KYC, Lam JMK, Zhu X-L, Poon WS. Features of Head Injury at Prince of Wales Hospital, Hong Kong, From 1989 to 1993. *HKMJ.* June 1996;2(2):141-145.

29. Bruns J, Hauser WA. The Epidemiology of Traumatic Brain Injury: A Review. *Epilepsia* 2003;44(10):2-10.

30. Saboori M, J A, Z. F. Indications for brain CT scan in patients with minor head injury. *Clin Neurol Neurosurg.* 2007;109(5):399-405.

31. Roghani IS, Ali M. Incidence of Intracranial Haemorrhages in Trauma of the Head on CT Scan Brain. *JPMI.* 1999;13(1):18-25.

32. Gonzalez C, Hernandez JAF, Ruiz AB, Hernandez AG. Analysis of minor head injuries treated in an Accident and Emergency Department. *Emergencias, Spain.* 200;19, 21-24(19):21-24.

33. Haaga J, Lanzieri C, Sartoris D, Zerbouni E. CT and MRI of the whole body. *St. Louis Mosby.* 2003(14th ed):317-350.

34. Guidelines for the acute medical management of severe 165"traumatic brain injury in infants, children, and adolescents. *Crit Care M ed.* 2003;3(31 (Suppl)).

35. Parkinson D. Head Injuries, a prospective, computerized study. *Can J Surg.* 1985;28(1):79-82.

36. Livingston DH, Lavery RF, Passannante MR. Emergency Department Discharge of patients with a Negative Cranial CT Scan after minimal Head Injury. *Ann Surg 2000.* July 2000;232(1).

37. Lee B, Newberg A. Neuroimaging in traumatic imaging. *The journal of the American Society for Experimental Neuro-Therapeautics Inc.* April 2005;2:373-383.

38. Corrigan D.J, Anbesaw S, A. OJ. The Epidemiology of Traumatic Brain Injury. *Journal of Head Trauma Rehabilitation.* 2010;25(2):72-80.

39. Farokhi MR, Taghipour M. Severe Head Injuries and ICP Monitoring Outcome in Southern Iran. *JRMS.* 2006;11(4):248-251.

40. Smits M, Hunink MGM, Rijsel DAV. Outcome after complicated Minor Head Injury. *American Journal of Neuroradiology.* March 2008(29):506-513.

41. Stuart G, Yelland JDN, Balderson G. 3000 Head Injuries: A Prospective study of patients admitted to Brisbane neurosurgical units. *Journal of Clinical Neuroscience.* 1998;5(4):402-405.

42. Youmans J. Neurological Surgery Philadelphia.WB. Saunders 2004(5th Ed):5019-5273.

43. Pruthi N, Chandramouli B, Sampath S, Devi B. Patterns of Head Injury among drivers and Pillion Riders of Motorised two-wheeler vehicles in Bangalore. *Indian Journal of Neurotrauma IJNT.* 2010;7(2):123-128.

44. Odero WO, Kibosia J. Incidence and characteristics of injuries in Eldoret, Kenya. *East Afr Med J.* 1995 Nov;72(11):706-710.

45. World Health Organization and Ministrt of Public Health and Sanitation Kenya.Factsheet: Motorcycle Related Road Traffic Crashes in Kenya Facts and Figures. 2011.

46. Kraus J, D F, Conroy C. Incidence, Severity and Outcomes of brain injuries involving bicycles. *Am J Public Health* 1987(77):76-77.

47. Ojo EO, Ibrahim AG, Alabi S, Obiano SK. Gunshot Injuries In A North Eastern Nigerian Tertiary Hospital. *The Internet Journal of Surgery.* 2008;16(2):1528-8242.

48. Asaleye CM, Famurewa O.C, Komolafe E.O, Komolafe M.A, Amusa Y.B. The Pattern of Computerized Tomographic findings in Moderate and Severe Head Injuries in Ile-Ife Nigeria. *West African Journal of Radiology.* April 2005;12(1):8-13.

49. Chan H, Jaalam WAK, Abdullah M, Abdullah J. Which Mild Head Injured Patients should have follow up after discharge from an accident and emergency ward? A Study in a university hospital setting in Kelantan Malaysia. July 2005;36(4):982-993.

50. Akama MK, ML C, FG M, SW. G. Pattern of maxillofacial and associated injuries in road traffic accidents. *East Afr Med J.* 2007;84(6):287-295.

51. Muula AS, Misiri HE. Physical trauma experience among school children in periurban Blantyre, Malawi. *International Archives of Medicine* 2009;2(20):1755-7682.

52. Mezue WC, Bashir EM. Head Injury Patterns in Qatar. *Pan Arab Journals.* 1998;2(2).

53. Kamal HM, AA M, Bokhary MM Aly. Traumatic brain injury in paediatric age group; Predictors of outcome in Paediatric Intensive Care Unit. *Liban jn Med.* (AOP 070210):90-94.

54. G.Stiell I, Wells GA, Vandemheen K. The Canadian CT Head Rule for patients with minor head injury. *Lancet.* 2001;357:1391-1396.

55. Naseri M, Tomasian A, Moghaddas AR. Correlation of CT Scan Findings with the level of Consciousness in Acute Head Trauma. *Iran J. Radiology.* June 2005;2(3,4).

56. Dalt DL, AG M, L L. Predictors of intracranial injuries in children after blunt head trauma. *Eur J Pediatr.* 2006;165(3):142-148.

57. Kuppermann N. Intracranial injury in minor head trauma. *Arch. Dis. Child.* 2004;89(593-594).

58. Mohammad Z, Shameem J, Munawwar H, Srivastava VK. A Study of the Pattern of Head Injury in District Aligarh U.P. India. *JIAF.* 2005;27(2):971-973.

59. Obajimi MO, Jumah KB, Brakohuapa WO, Iddrisu W. Computerized tomography features of head injury in Ghanaian Children. *The Nigerian Journal of Surgical Research.* July-Dec 2002;4(3):84-88.

60. Muyembe V, Suleman N. Head injuries at a Provincial General Hospital in Kenya. *East Afr Med J.* 1999;76(4):200-205.

61. Elias G.D. CT findings in head scans at Moi Teaching and Referral hospital. *East Afr Med J.* . May 1999;76(5):275-277.

62. Saurabh C, Tripathi C. Skull fracture and haemorrhage pattern among fatal and nonfatal head injury assault victims a critical analysis. *Journal of Injury and Violence Research.* June 2010;2(2):99-103.

63. Gan Bk, Lim JHG, Ng IHB. Outcome of Moderate and Severe Traumatic Brain Injury Amongst the Elderly in Singapore. *Annals Academic Medicine Singapore.* 2004;33(1):63-67.

64. Teasdale D, Jennet B. Assesment of Coma and Impaired Consciousness A practical scale. *Lancet.* 1974;II:81-84.

65. Greve MW, Zink BJ. Pathophysiology of traumatic brain injury. *A Journal of Translational and Personalized Medicine.* 2009(76):97-104.

66. Sherki YG, Rosenbaum Z, Melamed E, Offen D. Antioxidant Therapy in Acute Central Nervous System Injury: Current State*Pharmacological Reviews.* 2002;54(2):271-284.

67. Tang XD, Daggett H, Hanner M. Oxidative Regulation of Large Conductance Calcium-activated Potassium Channels*J. Gen. Physiol. The Rockefeller University Press.* 2001;117(3):253–273.

68. Dawson VL. Potent neuroprotectants linked to bifunctional inhibition*Proceedings of the National Academy of Sciences of the United States of America.* 1999;96(19):10557-10558.

69. Glauser J. Head Injury: Which patients need imaging? Which test is the best? *Cleveland Clinic Journal of Medicine.* April 2004;71(4):353-357.

70. Moser FG, Izadi K, Saidian L, Binesh N, Maya M, Pressman BD. Head CT Findings compared with MRI Within 48 hrs of Emergency Department Presentation. *JCOM.* Aug 2010;17(8):351-354.

71. Toyama Y, Kobayashi T, Nishiyama Y, Satoh K, Ohkawa M, Seki K. Computerized Tomography for Acute Stage of Closed head injury. *Journal of Radiation Medicine.* 2005;23(5):309-316.

72. National Institute for Health and Clinical Excellence, Head injury Triage, Assessment, Investigation and Early Management of Head Injury in infants, Children, and adults; *NICE Guidelines.*Sept. 2007: *No. 56.*

73. Rabie JA, Otto S, Roux AJL. Is CT of the Brain necessary in patients with clinically suspected depressed skull fractures and no focal neurological deficit. *SA Journal of Radiology.* June 2010:28-30.

74. Ogendi JOK AJ. Causes of injuries resulting in a visit to the emergency department of a Provincial General Hospital, Nyanza, western Kenya. *Afr Health Sci.* 2011;11(2):255-261.

APPENDICES

APPENDIX I: Consent form

A. ENGLISH:

My name is Dr Cornelius K. Koech. I am a qualified doctor, registered by the Kenya Medical Practitioners and Dentists Board. I am currently pursuing a Masters degree in Radiology and Imaging at Moi University. I would like to recruit you into my research which is to study patterns of Head CT scan findings in patients with head injury at MTRH.

ABOUT HEAD INJURY

Head trauma (HT) is any injury that causes lesion or functional damage of cranium, meninges and brain. It is the most frequent lesion seen in trauma related-death.

It can be mild, moderate or severe form of head injury and results from various causes including motor vehicle accidents, falls, or assaults from someone.

The mode of choice of diagnosis is by a non-contrast head ct scan soon after the injury which will identify any lesion that is present either in scalp, skull e.g. fracture (open or Closed) or within the brain tissue itself.

Open fracture means the skull is open to the outside and scalp is torn or cut while closed fracture is where the scalp remains intact despite the fracture in the skull being present.

Skull fractures can also be linear i.e. the bone fragments are in line though a fracture being there, or can be depressed where the fragments are pushed inwards towards the brain tissue and may result in compression of the brain itself causing more damage.

Bleeding may also result from head injury and may lead to different forms of intracranial bleeds, which include extradural hematomas, subdural hematomas or intracerebral hematomas.

Extradural hematomas occur between the inner surface of the skull bone and the outer covering of the brain called the dura. This leads to compression of the brain and is very fatal even causing death if not evacuated immediately.

Subdural heamatoma is one that occurs between the surface of the brain and the dura. It can be acute, meaning immediately after the injury, subacute, less than two weeks or chronic, more than two weeks. This manifests as headache which may be persistent and not relieved by analgesics hence the need for a head CT Scan to identify the pathology and aid in subsequent evacuation of the hematoma.

Intracerebral hematoma is that which bleeds into the brain parenchyma itself and may cause focal neurological deficits depending on the amount of blood in the brain itself.

Management of head injury depends first on diagnosis of the type of head injury by doing a head CT scan and classification of the severity of the head injury after which appropriate management principles are instituted for the type of head injury present.

This study intends to find out the patterns of CT scan findings in patients with head injury attending MTRH and their various causes so as to be able to understand and to assist in planning and implementation of interventions to reduce the occurrence of head injuries in this region.

We will keep all your results confidential and keep you informed of the results and what they mean. Treatment does not depend on your participation in this study. Appropriate treatment will be given for any condition that we find from assessing you and from your results.

This study has been approved by the Institutional Research and Ethics Committee (IREC) of Moi University/Moi Teaching and Referral Hospital.

If you need further clarifications please contact IREC using the address below.

The Chairman IREC,

Moi Teaching and Referral Hospital,

PO Box 3,

Eldoret.

Tel: 33471/2/3

My cell phone number is: 0720 866 225

YOUR CONSENT:

Adults above 18 years of age

I have been adequately informed that my Head CT Scan will be used in a study to describe the patterns of Head CT Scan findings in patients with head injury at MTRH. The investigator has also informed me that my participation in this study is voluntary and will not exclude me from treatment even if I were to opt out.

Sign: ……………………………………………………………………………………….

Name: ……………………………………………………………………………………….

Date: ……………………………………………………………………………………….

YOUR CONSENT:

Patients below 18 years of age

I have been adequately informed that the head CT Scan of my son/daughter will beused in a study to describe the patterns of Head CT Scan findings in patients with head injury at MTRH. The investigator has also informed me that his/her participation in this study is voluntary and will not exclude him/her from their treatment even if he/she were to opt out.

PATIENT'S PARENT/GUARDIAN:

Sign: ……………………………………………………………………………………….

Name: ……………………………………………………………………………………….

Date: ……………………………………………………………………………………….

B. KISWAHILI:

Jina langu ni Daktari Cornelius K. Koech. Mimi ni daktari aliyefuzu nakusajiliwa na bodi ya madaktari ya Kenya (Kenya Medical Practitioners and Dentists Board). Mimi ni msomi wa shahada ya juu (Masters) ya udaktari ya Radiology and Imaging katika chuo kikuu cha Moi. Ningependa kukusajili kwa huu utafiti wa kuangalia aina za shida zilizoko kwa kichwa zinazooyeashwa kwa picha ya CT Scan ya kichwa kwa wale ambao wameumizwa vichwa wanaoonekana hapa MTRH.

KUHUSU JERAHA KICHWANI

Jeraha Kichwani (Head Injury) ni kuumizwa kwa kichwa ambayo inasababisha majeraha kwa nyama inayofunika kichwa, fuvu au ubongo mwenyewe. Hii inaonekena mara nyingi kwa wale wanao angamia kwa sababu ya majeraha kichwani.

Inaweza kuwa kiwango ya chini, ya kiasi au mbaya sana na hutokana na sababu nyingi sana kama vile ajali ya barabarani, kuanguka chini au kupigwa na mtu kwa kutumia kitu Fulani.

Chombo kinachofaa kupimia kichwa wakati umeumia ni CT Scan ya kichwa ambayo hutapewa dawa ya kudungiwa kwa mishipa ya damu na itaonyesha shida yoyote kama iko kwa nyama ya kichwa, fuvu au kwa ubongo.

Kuvunjika kwa fuvu ni aina mbili, ile imefunguka (open) na ile haijafunguka (closed). Ile imefunguka inamaanisha kwamba fuvu limevunjika na linaonekana kutoka nje. Ile haijafunguka inamaanisha kwamba fuvu lililovunjika limefunikwa na nyama ya kichwa na halionekani kutoka nje.

Pia kuvunjika kwa fuvu linaweza kuwa limenyoroka (linear) au limedondoka ndani ambapo inaweza kusababisha kufinywa kwa ubongo na hii inaweza kuleta madhara mengi.

Damu inaweza kumwagika ndani ya kichwa kutokana na kuumia kichwani na ni aina tofauti. Ya kwanza inaitwa Extradural Hematoma na ni damu iliyo kati ya ndani ya mfupa wa kichwa na ile kitu inayofunika ubongo. Hii inasababisha kufinywa kwa ubongo na ni ya hatari sana na mtu anaweza kufa isipotolewa haraka kupitia upasuaji.

Ya pili inaitwa Subdural Hematoma, na hii ni ile damu inakuwa kati ya ubongo mwenyewe na ile kitu inachofunika ubongo (dura). Hii ni aina tatu pia, ya kwanza ni ile inayotokea baada ya kuumia(Acute), ya pili ni ile imekaa lakini imepitish wiki moja (Subacute), na ya tatu ni ile imepita wiki mbili (Chronic). Hii aina ya damu kwa kichwa husababisha mtu kuumwa na kichwa sana kwa muda mwingi na haipoeshwi na dawa za uchungu. Kwa hivyo picha ya kichwa (CT Scan) ni ya muhimu sana ili kuonyesha shida hiyo na hivyo kutolewa mapema.

Ya tatu inaitwa Intracerebral hematoma. Hii ni damu inaingia ndani ya ubongo mwenyewe na mtu anaweza kuwa na shida ya sehemu ya mwili kama vile kupooza kulingana na kiwango ya damu iliyomwagika ndani ya ubongo.

Matibabu ya kuumia kichwa inategemea kwanza kujua ni ya aina gani kwa kupiga picha hii ya CT Scan na kujua ni ya kiwango ipi, halafu sasa matibabu inayofaa kulingana na kiwango hicho kuanzishwa.

Utafiti huu unalenga kujua aina tofauti ya shida hizo za kichwa zinazotokana na kuumia kichwa kwa picha ya CT Scan ya kichwa kwa wale wamejeruhiwa vichwa wanaoonekana hapa MTRH. Hii itasaidia kuelewa kwa undani sababu zinazosababisha kuumia kichwa na baadaye kusaidia kwa hatua zitakazochukuliwa kupunguza kutokea kwa majeraha ya vichwa kwa upande huu wa nchi.

Tutayaweka matokeo yako kwa njia ya kuheshimu haki yako ya kutojulisha yeyote. Tutakujulisha kuhusu matokeo yako na maana kwa afya yako. Hatutakataa kukupa matibabu iwapo utachagua ama usichague kushiriki katika uchunguzi huu. Utapewa matibabu yafaayo kwa magonjwa yoyote tupatayo tukikuchunguza na yatakayopatikana kwa picha yako.

Uwe huru kuuliza maswali yoyote.Uchunguzi huu umehidhinishwa na kamati ya kusimamia machunguzi ya wasomi na haki ya wanaochunguzwa (Institutional Research and Ethics Committee-IREC) katika chuo kikuu cha Moi na hospitali kuu ya Moi Teaching and Referral.

Iwapo unahitaji maelezo zaidi tafadhali wasiliana na IREC kwa kutumia anwani ifuatayo.

Mwenyekiti IREC,

Moi Teaching and Referral Hospital,

S. L. P. 3,

Eldoret.

Simu: 33471/2/3

Nambari yangu ya simu ya rununu ni: 0720 866 225

HIDHINI YAKO:

Walio na miaka 18 na zaidi

Nimeelezwa ipasavyo ya kwamba Picha yangu ya CT Scan ya Kichwa itatumika katika uchunguzi wa usomi utakayo chunguza aina za shida zilizoko kwa picha ya CT Scan ya kichwa kwa wale walioumia vichwa wanaoonekana hapa MTRH. Mchunguzi pia amenieleza kuwa sitakosa matibabu yangu inayotakikana iwapo nitashiriki katika uchunguzi au sitashiriki.

Sahihi: ……….……………………………………………………………..…………………………….

Jina: ….……………………………..………………………..……………………………………

Tarehe: ……………………………………………………………………….…………………….

APPENDIX II: Data collection form

DEMOGRAPHICS

Date: …………………………. Medical Record Number: ……………………………

Age: …………………………… Gender: Male ☐ Female ☐

Glasgow Coma Scale: ……………………………………..

Referred………Yes/No From Where………………………….

HISTORY

1. **Cause/Mechanism of head injury**

Motor Vehicle Accident	Yes	☐	No	☐
Motor Cycle Accident	Yes	☐	No	☐
Fall	Yes	☐	No	☐
Assault	Yes	☐	No	☐
Bullet injury (Gunshot injury)	Yes	☐	No	☐
Bicycle accident	Yes	☐	No	☐

Others Unspecified ……………………………………………..

EXAMINATION

General:

Pallor	☐	Jaundice	☐	Edema	☐
Dehydration	☐	Lymphadenopathy	☐		

Height: ……………………..cm **Weight:** ……………………..kg

Vital signs: BP: …………/…………mmHg Pulse: …………………../min

Temp: …………………….^{o}C $SPO_{2:}$ …………………..%

Chest examination:

Normal ☐ Abnormal ☐

Heart examination:

Normal ☐ Abnormal ☐

Abdominal examination:

Normal ☐ Abnormal ☐

Nervous system examination:

Normal ☐ Abnormal ☐

Other findings

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………

2. **CT Scan Findings (Tick as appropriate)**

Finding	**Tick**
Normal	☐
Depressed Skull Fracture	☐
Comminuted Skull Fracture	☐
Scalp Hematoma	☐
Linear Skull Fracture	☐
Extradural Hematoma	☐
Acute Sub-Dural hematoma	☐
Chronic Sub-dural Hematoma	☐
Sub-Arachnoid Hemorrhage	☐
Pneumocephalus	☐
Cerebral Oedema	☐
Diffuse Axonal Injury	☐
Foreign Body	☐
Intracerebral Bleed	☐
Cerebral Contusion	☐
Intraventricular Bleed	☐

Others Unspecified ………………………………………………………………

3. **Other findings**

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

APPENDIX III: Procedure for doing a head CT Scan

The head CT Scans were done using PHILIPS MX 4000 Dual Slice CT scan Machine. The request was received and indication for the CT scan confirmed and recorded in the register along with the In-Patient Number. The patient was then positioned with the patient supine and head secured in position with pads on both sides and strapped in place to be firm.

The patient was then moved and positioned so that the head was in the gantry and laser light centered at midline and about 2.5 cm from the vertex so as to include the entire head. (This was because the movement of the patient was couch in, i.e. patient is moved inwards as the scan is done). The settings are set as follows, Kilo-voltage 120Kv, 150Mas, 80 WW and 35 WL.

The scan was started with a scanogram and necessary collimation done. Then necessary windows are set i.e. brain window, bone window to show brain and bones respectively. Scanning was then done with increments of 5mm from the base to the vertex.

The images were shown on the computer screen and any intracranial lesion was seen. The interpretation was done after which the images were then loaded onto the film format in the computer and the film printed.

APPENDIX IV: IREC APPROVAL

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2011/45

1st September, 2011

Approval Number: 000689

Dr. Cornelius Koech
Moi University
School of Medicine
P. O. Box 4606 - 30100
ELDORET, KENYA

Dear Dr. Koech

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee have reviewed your research proposal titled:

"Patterns of head computerized homographic scan findings in patients with head injury at the Moi Teaching and Referral Hospital."

Your proposal has been granted a Formal Approval Number: **FAN: IREC 000689** on 1st September, 2011. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 31st August, 2012. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Yours Sincerely,

02/09/2011

DR. W. ARUASA
AG. CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

APPROVED
01 SEP 2011

cc:	Director	-	MTRH
	Dean	-	SOM
	Dean	-	SPH
	Dean	-	SOD