

**AETIOLOGY, PATTERN AND MANAGEMENT OF ORAL AND  
MAXILLOFACIAL INJURIES AT MULAGO NATIONAL REFERRAL  
HOSPITAL: A TEN-YEAR AUDIT.**

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## DECLARATION

I Emmanuel Ituuza Tugaineyo declare that this research report is my personal work, submitted for partial fulfillment for award of Master of Dental Surgery Degree in Oral and Maxillofacial Surgery at the University of Nairobi. It has never been previously submitted for any other degree or examination at this or any other university.

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## **DEDICATION**

To all the victims of Oral and Maxillofacial injuries and their relatives whose lives have been affected in one way or the other as a result of these injuries.

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To God Almighty whose faithfulness is new every morning.

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## LIST OF ABBREVIATIONS

MNRH	-	Mulago National Referral Hospital
RTI	-	Road Traffic Injury
MVA	-	Motor Vehicle Accident
MCA	-	Motor Cycle Accident
IPV	-	Interpersonal Violence
FAI	-	Fire arm Injury
SI	-	Sport Injury
STI	-	Soft Tissue Injury.
ENT	-	Ear Nose and Throat
OMF	-	Oral Maxillofacial
OMFI	-	Oro- maxillofacial injury
ATLS	-	Advanced Trauma Life Support
O-RTI	-	Other causes of Road Traffic Injuries

## **DEFINITION OF TERMS**

### **Domestic Violence**

Broadly this refers to violence occasioned within a geographically demarcated area, (country, district, home/family, etc.).<sup>1</sup> In our study domestic violence refers to violence occasioned within a home/ family. It includes; spousal abuse, violence against a family member and intimate partner violence.

### **Non domestic violence**

According to our study non domestic violence refers to violence occurring outside the home/family e.g. violence occurring between people not in a domestic relationship.<sup>1</sup>

## **ABSTRACT**

**BACKGROUND:** Oral and Maxillofacial injuries (OMFIs) are commonly associated with general body injuries. The anatomical position of the region (the neurocranium and viscerocranium) makes it relatively more exposed than any other part of the body rendering it more prone to trauma. Injuries sustained in this area are often life-threatening as they may be associated with airway problems, feeding difficulties, cervical spine fractures and head injury. The resultant facial scarifications or deformities may cause esthetic problems that can lead to depression and socio-psychiatric disorders, like post traumatic stress disorder (PTSD). The degree of OMFIs largely depends on the aetiology and the activities the victim is involved in. The prognosis of the injured patient is dependent on both the initial emergency treatment and the eventual definitive treatment given to the victim. Both forms of treatment are dependent on availability of the necessary facilities and expertise in a given health facility that attends to the patient.

**OBJECTIVES:** The objective of this study was to assess the aetiology, pattern and methods of management of Oral and Maxillofacial injuries seen at the Oral and Jaw injuries unit of Mulago National Referral Hospital for a period of 10 years (2000-2009). The study was intended to assess the magnitude of Oral and Maxillofacial injury- patients managed at this unit.

**METHODOLOGY:** The study design was retrospective descriptive and cross-sectional, carried out on medical records of patients who were managed for OMFIs at the Oral and Jaw Injuries unit of Mulago National Referral Hospital (MNRH) over a ten-year period. The study site was at the Oral and Jaw Injuries Unit. The non-probability (convenience) sampling method was used and a minimum sample size was determined by applying the formula for prevalence studies.

However, the sample size depended on the number of patients' records that met the inclusion criteria. A pre-designed data collection instrument was utilised by calibrated research assistants and the principal investigator for data collection and windows SPSS version 17 was utilised for data analysis with guidance of a biostatistician. The results were presented in tables, graphs and pie- charts.

**RESULTS:** A Total of 1203 patients' records met the inclusion criteria for this research study and out of these 990 (82.3%) were males and 213(17.7%) were females, the ratio of male: female being 4.6: 1. The age-group most affected by OMFIs was the 21-30- year- olds and road traffic injuries (RTIs) were responsible for 61% (n=735) of the injuries whereas Interpersonal violence (IPV) was responsible for 27.6% (n=332) being the second most prevalent aetiological factor followed by Accidental falls 12% (n=142) and Firearm injuries (FAIs) 2.2% (n=27) respectively. In the present study it was also found that the most frequently injured part of the facial region was the lower part of the face which sustained 56% (n= 980) of all the OMFIs followed by mid-face 32% (n=560) and upper face 12% (n= 208). Isolated mandibular fractures were 62% of the skeletal injuries, whereas isolated mid-facial fractures involving the zygoma, zygomatic arches, maxilla and nasal bones were (24%). Pan-facial fractures accounted for 5.7% of all the Maxillofacial fractures. The most prevalent body injury associated with OMFIs was found to be head injury which accounted for 60.8% of all the associated injuries. The main radiological investigation carried out was plain radiography and the definitive management comprised mainly of soft tissue repair (60.43%). The skeletal fractures were mainly managed by closed reduction (46.47%) whereas open reduction with internal fixation (ORIF) was done on a small percentage of the patients (4.0%).

## **CONCLUSION**

OMFIs seen and managed at MNRH were mostly due to RTI and IPV, mainly affecting young males between 21 and 30 years old. The Patients presented with both STIs and skeletal injuries, the mandible and the lower face generally being the most affected part. Patients presented with diverse associated injuries the head injury being the most prevalent among them. The main mode of management of the facial fractures was closed reduction which included intermaxillary fixation with both eyelet wires and arch bars.

## **RECOMMENDATIONS**

- Since most of these injuries were caused by road traffic injuries especially motorcycle accidents (MCAs), preventive measures to minimise their occurrence need to be put in place and enforced. Public education on observation of road traffic regulations targeting the most affected segment of society should be done.
  
- Prospective studies on the main aetiologies of OMFIs like RTIs and IPV need to be done so as to establish their route causes and devise means of reducing their incidences.



## CHAPTER ONE

### INTRODUCTION AND LITERATURE REVIEW

#### 1.1.0 Introduction

In sub-saharan Africa, trauma is assumed to be prognostically worse than in many other regions of the world because almost 90% of the world's deaths from trauma occur in the low and middle- income countries, most of which are in sub-saharan Africa.<sup>2</sup> This is attributed to poorly developed casualty transport systems and ill-equipped health facilities to manage emergency life-threatening conditions. A Nigerian study by Ugboko et al. showed that only one-third of the patients were able to report for treatment within 24 hours after injury.<sup>3</sup> This was reportedly due to the unavailability or non-functional emergency services which worsened the prognosis of trauma victims.

Oral and Maxillofacial Injuries (OMFIs) are a major component of general body trauma of patients managed at Mulago National Referral Hospital (MNRH).<sup>4,5</sup> The aetiology of OMFIs varies from region to region, even within the same country the aetiological factors are influenced by socio-economic and environmental factors that exist in a particular area. People's culture and recreational activities may also influence the aetiology and patterns of OMFIs. The major aetiological factors world-wide include RTIs, interpersonal violence (IPV) and fire arm injuries (FAIs) among others. In the eastern and the horn of Africa region there is a proliferation of illicit trade in small firearms due to civil wars and intertribal rustling of domestic animals. The situation has been worsened by international terrorism that has engulfed Eastern Africa emanating from the Middle East, consequently increasing the prevalence of trauma from FAIs. Uganda has experienced several civil wars during which a variety of weapons including firearms,

machetes, knives and other crude weapons have been used leading to mortality and disabilities that required a multidisciplinary approach in their management. Industrial and sports-related OMFIs seem to be more common in the developed world compared to developing countries. Since OMFIs frequently present as a component of poly-trauma, specialist skills of general, maxillofacial, plastic, ENT surgeons and ophthalmologists are often required in order to adequately manage these injury victims.

## **1.2.0 Literature review**

### **1.2.1 Road traffic injuries**

Among the major causes of OMFIs in the sub-saharan region in general and those seen at MNRH in particular are road traffic injuries (RTI).<sup>3,5</sup> These include motor vehicle accidents (MVAs), motorcycle accidents (MCAs) and bicycle accidents. This can be attributed to poor road infrastructure among other factors. Some of the vehicles are mechanically defective and are therefore, more likely to get involved in road traffic crashes.

The motorcycle transport system locally known as “*boda boda*” has evolved as a means of circumventing traffic jams on major roads in Uganda and for its ability to pass through difficult terrain inaccessible to standard four wheel-vehicles. In addition to its versatility, the motorcycle is an affordable alternative means of transport for many people. Furthermore, most of the riders are self-trained with hardly any knowledge of road traffic rules, making a ride on a motorcycle highly prone to accidents. A by-law was passed by Kampala city council requiring motorcyclists to wear protective head helmets and to provide one for their passenger’s protection but this was resisted by the public.<sup>5</sup> The passengers were reluctant to share the same helmet for

fear of contagious disease transmission. The enforcement of this law and the impact it could have had on MCAs has not been documented.

In Nigeria a review of 442 OMFIs showed that approximately 72% of the patients sustained fractures from RTIs and 39% of the fractures occurred in the 21-30-year-old group.<sup>3</sup> According to the study done in Uganda, out of 378 jaw- fracture-patients 62% were due to RTIs.<sup>4</sup> The trend of RTIs in the developed world has been that of decline when compared to what is observed in most third world countries. This may be due to better road infrastructure, coupled with strict enforcement and observation of road traffic rules. The rising trend of RTIs in developing countries is demonstrated by studies done by Fasola AO et al. in Nigeria,<sup>6</sup> Brasileiro B F et al. in Brazil.<sup>7</sup> and Karyouti S M et al. in north Jordan.<sup>8</sup> A similar scenario has been observed regionally including Kenya where the trend of RTI as an aetiological factor of OMFIs was shown to be on the rise (Akama M K, Chindia M L, Guthua SW et al.).<sup>8</sup>

A Study done in Malaysia by Hussain H M et al. at Kajang hospital showed that out of 313 patients with maxillofacial injuries 79% were males and those between 21 and 30 years old (34%) were the majority. RTIs were the main causes of soft-tissue injuries (75%) and the MCAs were the most frequent (40%).<sup>10</sup> In a study done by Saeed A C et al. on OMFIs seen at Mayo Hospital (Lahore- Pakistan), 84% of patients were males and 16% females. OMFIs were most common in the third decade of life (31%) and in the second decade of life (24%). The most common cause was RTI (54%) followed by falls from heights (19%). The mandible was the most common bone fractured (67%) followed by the zygoma (30%) and maxilla (28%).<sup>11</sup> These findings compared well with what was observed in Ugandan studies and showed that RTI was one of the major causes of OMFIs in developing countries affecting mainly males who were in their second and third decades of life.

### 1.2.2 Interpersonal violence

In many developed countries IPV is increasingly becoming a major cause of orofacial trauma; this is mainly attributed to alcohol and drug abuse. Magennis P et al. At The University of Wales (UK) showed that increasing violence more than compensated for the decreasing road-trauma. Whereas for the period 1977-1987 severe RTI-related injuries had decreased by 38%, violent crime had risen by 77%. Assault-related injuries had risen from 40% to 50% and the trend had been on the rise since then.<sup>12</sup> Kai H L et al. at Waikato hospital (New Zealand) observed a similar trend.<sup>13</sup> These studies showed that IPV has become a major cause of orofacial injuries in the developed world. This scenario is gradually unfolding in the developing world due to changes in people's life style. The youth are the main victims of drug and abuse of other addictive substances including alcohol. This has contributed to an increase in IPV-associated orofacial injuries among the group. Findings from a Kenyan study by Mwaniki DL and Guthua S W. showed that IPV was responsible for 74.9% of the mandibular fractures.<sup>14</sup> Another study done in Zimbabwe by Chidzonga M M showed that IPV accounted for 89.8% of all the mandibular fractures managed at Harare Central Hospital and 80.7% of the victims were males.<sup>15</sup> According to a previous study from Uganda however, IPV accounted for only 25% of the jaw fractures.<sup>4</sup> Mandibular and jaw fractures in general are a major component of OMFIs and this shows that in some of the developing countries just like in most of developed countries, IPV is a major aetiological factor of OMFIs.

Some studies from the developed countries have shown an association between OMFIs and alcohol/drug abuse. Gerber P et al. showed that 55% of assaults that led to facial injuries in women that reported to Queen Elizabeth medical centre Birmingham (UK) were alcohol-influenced.<sup>16</sup> Laverick S et al. showed that the highest cause of referrals for OMFIs to three

medical centres in the United Kingdom between 2003 and 2004 was IPV and the age-group most involved was between 20 and 29 years (57%) for both females and males, the most affected being males (89%).<sup>17</sup> Another study by Chege E et al. at The University of Dundee Teaching Hospital (UK) found that among all patients who underwent surgery for maxillofacial trauma over a one-year period, IPV (51.7%) was the most common cause of Maxillofacial trauma and alcohol was a common factor in 30.9% of all the trauma cases.<sup>18</sup> This was in tandem with the observation that IPV due to substance abuse especially alcohol was the leading cause of OMFI in the developed world.

### **1.2.3 Firearm Injuries**

Firearms in the hands of gangsters and indisciplined forces have become a menace in countries in eastern Africa and the horn of Africa. Perpetual civil wars, intertribal and cross-border livestock rustling have led to many groups acquiring illegal firearms. The situation is compounded by urban banditry, highway robberies, cases of homicide, suicide and accidental injuries. Firearm injuries (FAIs) tend to be penetrative in nature. They may be avulsive, cause through and through wounds, or get lodged in body parts. This may depend on whether the injuries sustained are due to high or low velocity missiles, the calibre of the firearm and the firing range. Most victims die on the spot or soon after the incident from injury to vital organs or from haemorrhage. Survivors of gunshot injuries to the orofacial region may lose both soft tissues and skeletal structures often leaving extensive unsightly facial defects.

A study by Dobson J E et al. on the trends of maxillofacial injuries in war-times (1914-1986) found the mean incidence of head and neck war-injuries to have stagnated around 16%. This was found to have been greater than expected in terms of random wounding, the area being

about 12% of the body surface. It was concluded that maxillofacial surgeons remain an indispensable part of casualty care in modern war-fare. It was also observed that terrorist activity appeared to have given rise to more head and neck injuries than either rural attacks or major conventional wars.<sup>19</sup> Odhiambo W A et al. described the pattern of maxillofacial injuries sustained after the August 1998 bomb blast that occurred in Nairobi- Kenya. Out of the 290 bomb-blast survivors admitted at the Kenyatta National Referral and Teaching Hospital, 78% had sustained one or more OMFIs. Soft-tissue injuries (STIs) were the most common constituting 61.3% of all the injuries in the Maxillofacial region. 27.6% had severe eye injuries while 1.4% had fractures in the craniofacial region. From this paper it was concluded that effective management of bomb-blast injuries requires a multidisciplinary approach.<sup>20</sup> The high percentage of OMFIs confirmed that Maxillofacial surgeons should form an integral part of this multidisciplinary team. Odhiambo W A et al. in another study demonstrated an increase of FAIs in Kenya cutting across all age-groups the male adult between the 3<sup>rd</sup> and 4<sup>th</sup> decades of life being the most affected.<sup>21</sup> Hollier L et al. in a 4-year case series demonstrated that 75% of gunshot victims sustained orofacial injuries.<sup>22</sup>

#### **1.2.4 Sport-related injuries**

A proportion of OMFIs arises from contact sports and industrial or occupational accidents but to a lesser extent in the sub-saharan region when compared to the developed world. A review of Maxillofacial fractures over an 11-year period by Joseph S A et al. found that 20% of Maxillofacial fractures in western Europe were sports-related and mostly occurring in males.<sup>23</sup> In a sub-saharan country like Nigeria; one study showed that 3.2% of OMFIs were sports-related while industrial accidents contributed only 2.0% of the injuries.<sup>3</sup> In a Ugandan study; only 0.8% of jaw fractures were due to sport- injuries.<sup>4</sup>

Trauma from sports is often due to direct body contact between players, contact with high velocity sport-projectiles hitting unprotected players and contact with sport-equipment or sport-surface hence most of the injuries sustained are crush-injuries. Soft tissues are mostly involved but occasionally players sustain fractures and vital organs like the brain may be affected leading to brain concussions, contusions or intracranial haemorrhages that may be fatal. In the orofacial region the victims may sustain nasal fractures, injury to the orbit and the eyeball, loss of teeth and jaw fractures. A number of contact sports like rugby, football, sports with projectiles like cricket and hockey are popular in Uganda, therefore, a more comprehensive study on the aetiology of OMFI needed to be done in order to verify their association with sports. Where sports protection gear is mandatory and available, sport-related injuries are likely to be minimized. It was estimated that sports accounted for 3-29% of all facial injuries and facial trauma accounted for 11-40% of injuries seen by medical professionals; (Romeo S J et al.2005).<sup>24</sup> According to the American college of sports medicine sport-injuries were mostly reported among males aged 10-29 years; (Echlin P et al. 2004).<sup>25</sup>

### **1.2.5 Fall from heights**

These injuries are most common among young children especially toddlers and the elderly; (Seiji L et al.2003).<sup>26</sup> According to one study by Hussain K et al. in young children the injuries sustained mainly involved soft tissues. They presented as abrasions, lacerations, tongue bites or tooth avulsions.<sup>27</sup> Kotecha S et al. found that in the elderly such falls may be complicated by bone fractures especially around the neck of the femur or they may sustain life-threatening head injuries.<sup>28</sup> In one Kenyan study by Muriithi H M et al. at Kenyatta national hospital on dental injuries in 0-15-year-olds; falls accounted for 73.5% of the injuries. The findings were

higher in boys (63%) and girls accounted for 37%.<sup>29</sup> In children however, OMFIs may also be due to child abuse either by parents or guardians but often they are reported as being due to falls.

### **1.2.6 Animal attacks**

Animal attacks on human beings can be in form of bites, kicks, crashes, mauling or goring depending on an individual animal's defence mechanism. The injuries sustained by the victims therefore, vary according to different animals. Some of the injuries may be penetrative to the skin whereas others may be blunt crash injuries. The commonest animal bite to a human being is from the domestic dog. Bolts R W et al. showed that domestic dog bites were the major cause of animal-related injuries and were highest in children below 10 years old.<sup>30</sup> Statistics also show that at least 50% of Americans sustain dog bites in their lives. According to a study done by Ugboko VI et al. on facial injuries caused by animals in northern Nigeria; of the 37 cases reviewed 14 were by cows, 9 by camels, 6 by donkeys and there were only 3 dog bites.<sup>31</sup>

Inhabitants of areas close to game parks or reserves are prone to attacks from wild animals some of which are the biting type. The animal bite injuries mainly involve soft tissues that may present as lacerations or tears in the orofacial skin and muscles. These injuries may lead to both tissue loss and disfigurement of the victim that may be a challenge to repair; (Guthua S W. 1999).<sup>32</sup> Bites from the canine family may transmit very virulent microorganisms such as the rabies virus and bacterial infections like staphylococcus, streptococcus and *pasteurella* microbes. Bites from the cat family usually transmit infections caused by *Pasteurella multocida* microbes; (Talan D A et al.1999).<sup>33</sup> All these infections require urgent medical and surgical intervention that includes antibiotics, immunization and surgical debridement of infected dead tissues.



### **1.2.7 Human bites**

Human bites are a subset of IPV, however, they deserve special attention because of the nature of tissue destruction and the associated fatal infections they are likely to transmit. The human oral micro flora is unique and more virulent than that of other animals, making the human bite a medical emergency. Transmission of infections especially hepatitis A, B, C, tetanus and HIV are likely from human bites; (Merrian C V et al.2003).<sup>34</sup> At Mulago hospital a number of orofacial injuries from human bites have been reported, however, they have not been properly documented. In Kenya; Koech K J et al. found that males were more affected by these injuries than females.<sup>35</sup>

### **1.3.0 Pattern and clinical presentation**

#### **1.3.1 Soft tissue injuries**

Soft tissue injuries (STIs) present in various patterns depending on the aetiology. RTI-related STIs often present as abrasions, lacerations and sometimes involve full thickness skin loss and muscle. The soft tissue loss may be extensive requiring plastic surgery expertise to repair. Severe injuries to orbital contents may lead to permanent blindness in the affected eye. (Guthua SW 1999).<sup>32</sup> STIs due to IPV usually present as shallow or deep cuts. This usually depends on the type of weapon used ranging from knives, machetes to blunt objects like clubs and fist-fights. They may cause non-penetrative crush injuries or deep penetrating injuries and may involve vital structures like nerves and major blood vessels that would require emergency medical and surgical attention. STIs from both animal and human bites are usually considered infected (dirty wounds) at the time of presentation because of the resident micro flora in the saliva. Occasionally there is extensive soft tissue loss that requires meticulous surgical

debridement of dead tissue occasioning defects that are quite a challenge to repair; (Akama M K. 2000).<sup>36</sup>

### **1.3.2 Skeletal injuries**

#### **The facial skeleton:**

The facial skeleton can be divided into thirds. The upper third consists of the frontal bone and ends at the level of the supraorbital ridge.

The middle third of the face is the most prominent and complex. It extends from below the supraorbital rims to the incisal edges of the upper teeth. This region consists of the orbits, the nasal bones, the zygoma and the maxillary bones. The cone-shaped orbital space is composed of 7 bones: frontal, zygomatic, sphenoid, lacrimal, maxillary, palatine, and ethmoid. The periorbital bony rim serves as an attachment for the suspensory ligaments of the eye and the protective framework of the globe and optic nerve. The zygoma, along with the maxilla, gives the malar projection of the midface anteriorly. Laterally, it articulates with the temporal bone to form the zygomatic arch. The nose projects from the mid face and is composed of both cartilage and bone to give it the characteristic shape.

The lower third of the face is the mandible and the teeth it supports. The condylar processes are considered part of the lower third, they articulate with the temporal bone to form the cranio-mandibular joint.

Presentation of skeletal injuries in the maxillofacial area varies depending on the aetiology. Most injuries that go beyond the soft tissues lead to loss or fractures of teeth and often

cause fractures of the alveolar process. Injuries associated with RTIs range from simple fractures involving a single facial bone to multiple comminuted pan facial fractures. The presentation of these injuries also varies according to the means of transport and whether the victim was a driver/ rider, passenger or pedestrian. The seriousness of injuries depends on whether the victim had any protective gear like crash-helmet, safety belt or whether a motor vehicle had air bags. The surface impact with the face; like windscreen, concrete or metal has a bearing on the magnitude of skeletal trauma sustained by the victim. A study by Fadekemi. O O etal. on motorcycle-related maxillofacial injuries among Nigerian intracity road users showed a significant male preponderance and the victims were mostly riders (50.5%). While 8.4% of the accidents occurred on motorcycles with more than one passenger, none of the victims reported using a crash helmet. The mechanism of the accidents was mostly head-on collisions (39.2%). The injuries sustained were predominantly STIs or in combination with bone injuries. Bone and dental injuries were attributed mostly to falls and facial bone injuries occurred mostly in the mandible. A symmetric distribution of injuries was observed in the upper, middle and lower thirds of the face but the middle third had the highest injury sites while the upper third had the least injuries.<sup>37</sup>

Skeletal trauma presentation due to firearms depends on the range from which the missile is fired and the calibre of the gun used. These are mainly penetrative in nature and are often fatal especially when they involve the upper third of the face or when they cut through the major blood vessels transiting between the neck and the cranial cavity near the base of skull.

### **1.3.3 Associated injuries**

The major injury that often occurs in association with oral and maxillofacial trauma is head injury, which might present as closed or open in nature. A study done in Kenya showed that head injury occurred in 15-48% of all reported maxillofacial injuries; (Akama M K et al.2007).<sup>9</sup> Injuries involving the zygomaticomaxillary complex (ZMC) are often associated with ocular injuries and orbital floor fractures. These injuries require the combined effort of a maxillofacial surgeon and an ophthalmologist.

Other severe injuries associated with OMFIs are those of the cervical spine. Depending on the level of the spinal cord at which the injury occurs and the degree of severity, these injuries may be fatal or lead to varying degrees of incapacitation. Associated anterior neck injuries may cause laryngeal oedema or laryngeal fractures and may compromise the airway requiring an emergency tracheostomy. Concurrent injuries may also involve distant body parts from the orofacial area like limb fractures, chest, spleen or liver injuries which may be life-threatening and require urgent priority intervention.

### **1.4.0 Diagnosis and management of OMFIs.**

OMFIs are at times accompanied by other body injuries that may be life-threatening. Mortality is rare, however, patients with OMFIs may die from airway obstruction due to massive blood clots, broken teeth, oral implants and dentures. Cervical spine fractures are major life-threatening injuries that may lead to death or permanent neurological damage. A massive head injury involving the base of the skull may extend to the cranial fossa resulting in fatal neurological problems, whereas ascending infections from the nasal cavities may lead to meningitis; (Tung T C et al. 2000).<sup>38</sup> Survivors of OMFIs if not properly treated may heal with

facial deformities that pose both functional and aesthetic problems that require costly reconstructive surgery. Those who cannot afford reconstructive surgery live with deformities that may affect their psycho-social performance as well as function as was shown in a study by Auerbach M S et al.<sup>39</sup>

The initial management of a Maxillofacial trauma patient requires a good knowledge of airway management options. Deciphering clinical clues in diagnosing uncommon injuries requires a high index of suspicion. Knowledge of the Advanced Trauma Life Support (ATLS) protocol is essential in the management of an acutely injured Maxillofacial patient; (Perry M et al. 2008).<sup>40</sup> The A(*airway*), B(*breathing*), C(*circulation*), D(*disability*), E(*exposure*) guideline has to be followed in clinical assessment of the injured patient during the primary survey and attention to life-threatening situations carried out. Thereafter the injured patients are transferred to designated wards where a secondary survey and definitive modes of treatment can be done.

#### **1.2.4 Investigations**

Management of OMFI's needs proper clinical evaluation before charting out comprehensive management procedures. Imaging techniques like plain radiographs including orthopantomograms (OPG), CT-scanning, Doppler ultrasound and arteriography are most essential in the evaluation of both skeletal and STIs. Baseline laboratory investigations are also necessary to establish the biochemical and haemodynamic condition of the patient. However, sometimes the facilities to carry out optimum investigations are not readily available and the clinicians have to depend on clinical examination and available investigations to manage these patients.

### **1.2.5 Treatment**

Treatment of a patient with OMFIs can be broadly divided into 2 categories: (a) Emergency treatment, (b) Definitive treatment. However, the main objective of treatment of OMF injuries is to save life, then restore the pre-injury status of the patient which includes restoration of both function and aesthetics.

#### ***(a) Emergency treatment***

This is mainly carried out in the casualty department where the ATLS protocol of management approach needs to be strictly observed. The Glasgow coma score of the patient has to be assessed and urgent interventional measures instituted to save the patient's life. Some facial injuries may not be as life-threatening as they present. One needs to make sure the airway is patent, haemorrhage is stopped and the patient is stabilized then the OMFIs can be attended to later. Appropriate antibiotic coverage, analgesics, anti-inflammatory drugs and vaccines should be administered depending on the cause of the injuries. Tetanus toxoid vaccine or tetanus immunoglobulin can be given depending on the immunisation history of the patient, but in case the immunisation history is unknown tetanus toxoid has to be given. Where an animal bite is the cause of injury it is important to know whether the animal involved was wild or domesticated and inquire about the patient's immunization history against rabies. Then a decision can be made on the mode of giving anti-rabies vaccine to the patient. Human-bite injuries may require prophylactic treatment against hepatitis and human immunodeficiency viruses in addition to the anti-tetanus vaccine.

***(b) Definitive treatment***

In an ideal situation facial injuries should be repaired within 8 hours of insult. The fractures should be reconstructed first, followed by repair of STIs. If the patient is unstable repair can be delayed up to 72 hours post-injury. Delay beyond 3 days leads to healing by secondary intention with scar formation and would entail secondary wound closure. Secondary wound closure is also indicated for dirty wounds and contaminated wounds. Soft tissue loss if extensive may require local mobilization of tissue flaps or sourcing of distant grafts to cover the defects. The skeletal injuries may require simple closed reduction and immobilization of the fractures or open reduction and internal fixation (ORIF) of the fractures with plates and screws or wires. Management may be done singly by a Maxillofacial surgeon or may require multidisciplinary action of a plastic, ENT, neurosurgeon and an ophthalmologist.

According to the studies done in Uganda most of the OMF fractures were managed by closed reduction using intermaxillary fixation with eye-let wires and arch bars. Where ORIF was considered a better mode of management as in mid-facial fractures, wire osteosynthesis was applied. Only 0.3% of patients were treated by ORIF with plates and screws.<sup>4,5</sup> In more privileged economies of the world, however, OMFI- patients are more likely to be treated by ORIF because of availability of materials, purchasing power of the population and the presence of trained manpower to perform the operations. This was demonstrated by a study done in Turkey by Erol B et al.<sup>41</sup>

## **CHAPTER TWO**

### **2.1 Study site**

Mulago National Referral Hospital (MNRH) is situated in Kampala the capital city of Uganda. It is a complex comprising of old and new mulago hospitals. It is the teaching hospital of Makerere University College of health sciences and was opened in 1963 with a bed-capacity of 1500. The Oral and jaw injuries unit where this study was based is situated in the new Mulago part of MNRH whereas the rest of the dental services are offered in the old mulago section of the hospital complex. The Oral and Jaw injuries unit runs an out-patient clinic from Monday to Friday where on average 25 patients with Oral and Maxillofacial surgical conditions are attended to daily. The unit also runs an in-patient surgical ward with a capacity of 20 beds. All the patients referred with Oral and Maxillofacial surgical conditions to MNRH are attended at this unit. It serves a large population of Kampala city and receives referral cases in the country and even beyond the borders like the Eastern Congo region, Southern Sudan and parts of Western Kenya.

### **2.2 Problem statement**

According to previous studies done in Uganda and elsewhere OMFIs were seen to be an integral component of general body trauma attended to in emergency units of most health centres. Both bone and soft tissue injuries of the Oral and Maxillofacial area are occasionally fatal while the survivors sustain disabilities and deformities that may compromise their quality of life if not adequately managed.



### **2.3 Justification**

An audit of OMFIs managed at the Oral and Jaw injuries unit of MNRH was intended to demonstrate the health burden on this institution in particular and the nation in retrospect; MNRH being the only health institution in the country with facilities to offer definitive management for such patients.

There was also a need to compare the magnitude of OMFIs in Uganda with what pertains in the region and internationally. The study might demonstrate the need for training of manpower to manage these patients and to equip the regional referral hospitals so as to decentralise management of these patients from MNRH. The results may act as a reference point for future evaluation of any preventional and interventional measures currently in place and influence formulation of future patient management protocol.

## CHAPTER THREE

### 3.0 Material and methods

#### 3.1 Study population

The study included all patients who were seen, diagnosed and treated for OMFIs at the Oral and jaw injuries unit of MNRH, from January 2000 to December 2009.

#### 3.2 Sample selection

##### a) Sampling method

It was a non-probability (convenience) sampling method, where all patients who presented with OMFIs and were treated at the Oral and Jaw injuries unit of MNRH year by year consecutively from January 2000 to December 2009 were considered.

##### b) Sample Size

The sample size was based on the number of patients with OMFIs who presented to the Oral and Jaw injuries unit of MNRH for that period of ten years whose records could be retrieved from the medical records office and who met the inclusion criteria. Determination of the minimum sample size was based on previous study records. 132 patients with OMFIs were treated at MNRH in 6 months; this gave an estimate of 264 patients in one year and approximately 2640 patients in 10 years. Then the formula for prevalence studies was applied to determine the minimum sample size relevant to the study.

- $n = Z^2 P(1-P)/d^2$
- $n =$  Desired sample size when  $n > 10,000$

- Z= Standard error corresponding to 95% confidence level.
- d= degree of accuracy
- p= proportion of target population estimated to have OMFIs.

$$(1.96)^2(0.264)(0.736)/(0.05)^2 = 298$$

Therefore, the minimum sample size that would make the study viable = 298 patients.

### c) Inclusion Criteria

- (i) Patients who were diagnosed and treated at the Oral and jaw injuries unit of MNRH for OMFIs.
- (ii) Poly-trauma patients who were seen at other health centres for general body trauma and referred to the Oral and jaw injuries unit of MNRH for management of OMFIs.

### d) Exclusion Criteria

- (i) Patients whose OMFIs had been treated elsewhere, but referred to MNRH for second opinion and follow-up.
- (ii) Patients whose files were missing information of importance to the study.

## 3.3 Study design

It was a descriptive cross-sectional retrospective study covering a period of 10 years from January 2000 to December 2009.

### **3.4 Data collection**

Data was obtained from the patients' files and where possible records of investigations done before and after treatment were obtained. A pre-designed data collection form was utilized and the data was entered by calibrated research assistants and the principal investigator (PI). The file numbers were recorded for ease of verification. Two dental intern doctors conversant with Oral and Maxillofacial terminologies were engaged as research assistants. Calibration of research assistants and the PI in the utilisation of the data collection instrument was done by the supervisor to ensure that relevant information was captured by each participant. Preliminary testing of the data collection instrument was done by the team before the real data collection began. The testing exercise was done on 10 patient-files and the research assistants were calibrated against the PI. kappa values of 0.8 and 0.9 respectively were obtained signifying good agreement between the research assistants and the PI. The relevant data from patient-record files were then transferred to the data collection forms.

Data regarding age, gender and aetiology of injury was recorded. Aetiology of injury was recorded by using appropriate abbreviations, for example road traffic injury was recorded as RTI. Patterns of injury were represented by codes as per attached data collection instrument for ease of recording purposes (Appendix-1).

### **3.5 Results presentation**

The final results were presented in tables, bar graphs and pie charts.

### **3.6 Data analysis**

A computer with Statistical package for the social sciences SPSS version 17 for windows was used for analysis and testing for the statistical significance of some variables. A bio-statistician was consulted on data handling. Analysis of aetiology, pattern of clinical presentation and mode of treatment was done and correlation between the patterns of clinical presentations of OMFI and the aetiology was established.

#### **Minimizing errors and biases:**

- (a) Only patient-files that met the inclusion criteria were utilized and the persons involved in data collection were calibrated as a team on the use of the data collection instrument.

### **13.7 Ethical considerations and approval**

- (a) Clearance for the study was sought from the MNRH research and ethics committee and approved (see appendix 11).
- (b) Patients' file numbers were recorded instead of names in order to conceal peoples' identity.
- (c) The purpose of the information obtained was for strict use in this research only.
- (d) A copy of the research findings of this study will be submitted to MNRH research and ethics committee on completion of the study.

## **CHAPTER FOUR**

### **4.0 Objectives and study variables**

#### **4.1 Broad objective**

To determine the aetiology, pattern and management of OMFIs that presented at the Oral and Jaw injuries unit of MNRH over a period of 10 years (2000-2009).

#### **4.2 Specific objectives**

- (1) To determine the aetio-demographic factors of OMFIs among patients that presented at the Oral and Jaw injuries unit of MNRH.
- (2) To determine the pattern of OMFIs sustained by the patients that presented at the Oral and Jaw injuries unit of MNRH.
- (3) To determine the treatment modalities employed for OMFIs at the Oral and Jaw injuries unit of MNRH.

#### **4.3 Study variables**

(1) **Demographic data:**

- (a) Age,
- (b) Gender
- (c) Residence.

**(2) Independent variables:**

**Aetiology:**

- a) Road traffic injuries,
- b) Interpersonal violence,
- c) Sport injuries
- d) Animal/ Human bites,
- e) Fall from heights,
- f) Others (e.g. Medical conditions, industrial injuries etc.)

**3) Dependent variables:**

Type of the OMF injury: soft tissue, skeletal or both.

- (a) Anatomical site involved: upper third, middle third or lower third of face.
- (b) Special structures involved: Nerves, Major blood vessels, Eye ball, Glands and Salivary gland ducts.
- (c) Skeletal structures involved: The mandible and its different parts, isolated mid-facial fractures, Complex mid-facial fractures and upper facial fractures.
- (d) Other associated injuries: Head injury, Chest injury, abdominal injuries and other skeletal injuries.

(e) Complications: Airway obstruction, Bleeding, Infections and Mortality.

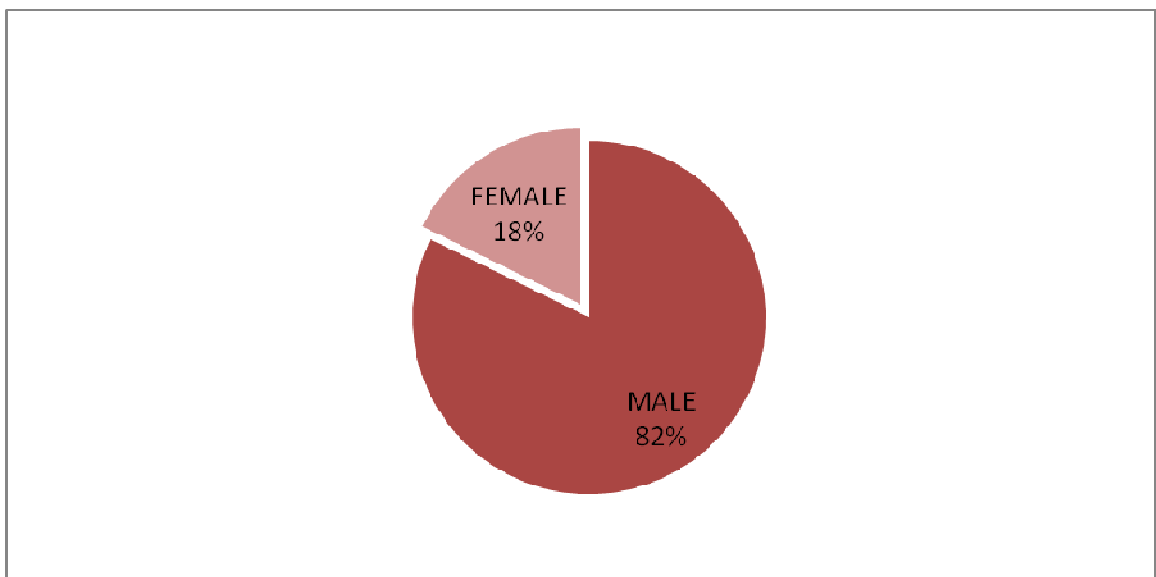
(f) Treatment: Emergency and Definitive.

(g) Cadre of medical personnel who attended to the patient: Maxillofacial Surgeon, Dentist,  
Intern.

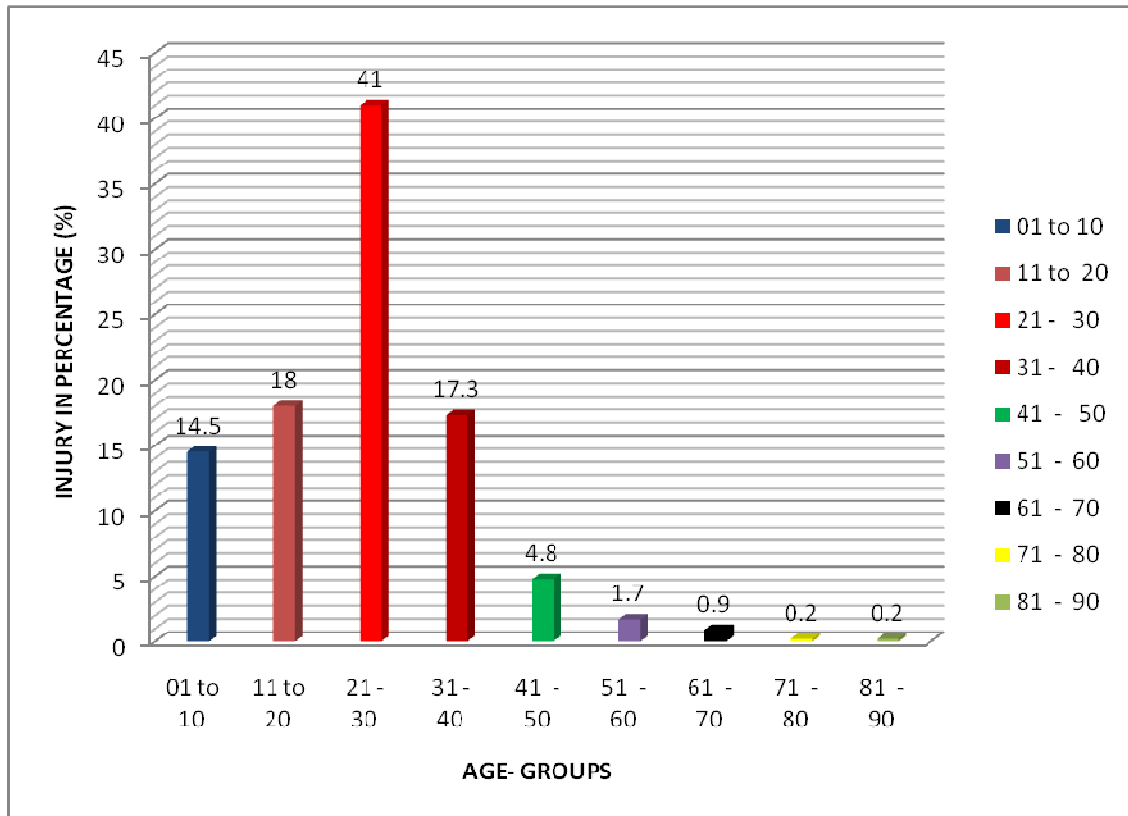


## CHAPTER FIVE: RESULTS

The number of patient-files that met the inclusion criteria was 1203 for the 10 years. Males (n= 990), females ( n= 213). The ratio of male to female was 4.6:1 the age range of the victims was 1-90 years. The population mean age was 25.82( $\pm$  15.13 STD), the mean age for males was 26.55 ( $\pm$  14.44 STD), whereas the mean age for females was 22.43 ( $\pm$ 17.63 STD). The Chi-square test for injury by gender was statistically significant at ( $P < 0.05$ ). This infers that males were more prone to OMFIs in this study.



**Fig. 1: Distribution of OMFIs by gender**



**Fig . 2: Distribution of OMFIs according to age-groups**

Fig.2 shows the age-group that was most affected by OMFIs was the 21-30 year- olds followed by the 11-20 and 31-40 year olds respectively. The other age groups were much less affected and the trend dwindled with advancement in age-groups.

**Table 1: Distribution of injury according to gender and aetiological agent (n=1203).**

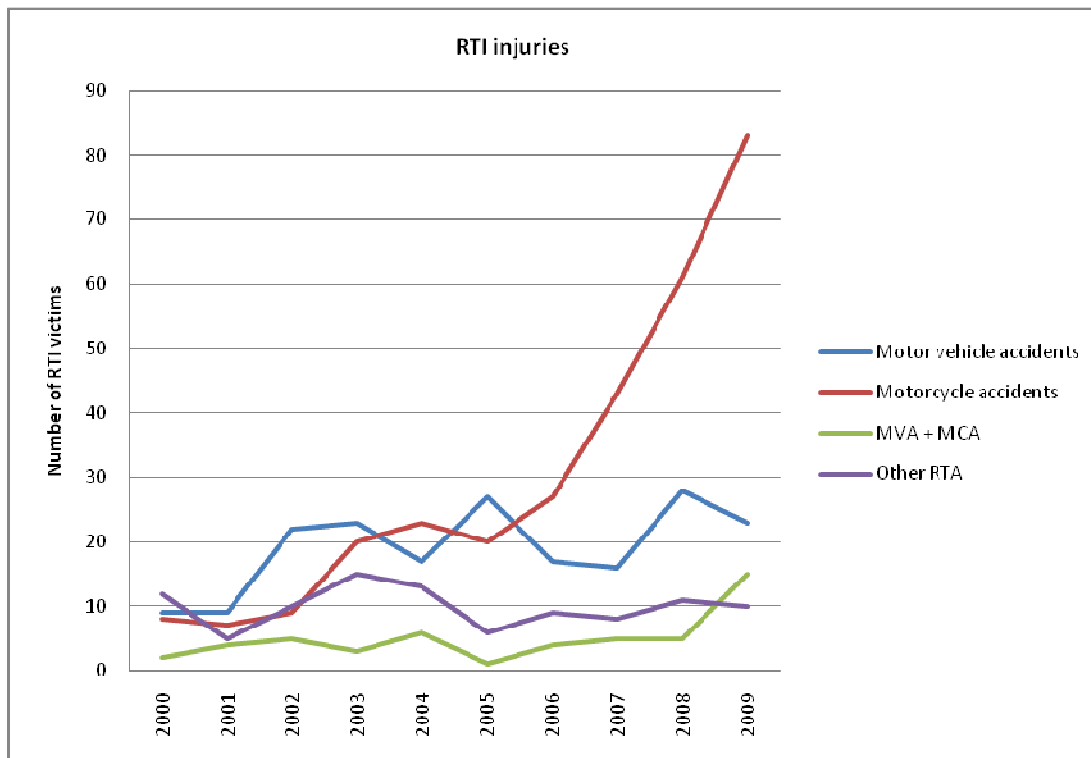
AETIOLOGY	Male	Female	Total	Percentage (%)	P-value
MVAs	214	50	264	22	0.000
MCAs	314	58	372	31	0.000
Other RTIs	86	13	99	8.2	0.000
Accidental falls	94	48	142	12	0.000
IPV	295	37	332	28	0.000
Sport-Injury	11	0	11	0.9	0.000
Animal Attack	10	4	14	1.2	0.000
FAIs	24	3	27	2.2	0.000
Other Causes	29	6	35	2.9	0.000

Table1. shows that for every aetiological factor males were more prevalent victims of OMFIs. The main aetiological factors were; (1) Motorcycle accidents (MCAs), (2) Interpersonal violence (IPV) and (3) Motor vehicle accidents (MVAs) respectively. Other aetiological agents accounted for lower proportions of OMFIs. In general the main aetiological factor was RTI (MCAs+ MVAs + Other RTI) accounting for a total of 61.2% of all the injuries, followed by IPV (28%). The motorcycle was the single most aetiological factor, being responsible for 31% of all the OMFIs. The Chi-square test for each aetiological agent versus gender was statistically significant with  $p < 0.05$ . This was an indication that the male gender was more prone to OMFIs.

**Table 2: Victims of RTI according to aetiology (n=735).**

	Passenger	Pedestrian	Motorist	Motorcyclist	Bicycle rider	Others	Total	%
<b>Motor vehicle</b>	97	97	6	44	17	3	264	35.9
<b>Motor cycle</b>	111	70	1	173	16	1	372	50.6
<b>Bicycle</b>	9	14	0	2	73	1	99	13.5
<b>Total</b>	217	181	7	219	106	5	735	
<b>%</b>	29.5	24.6	1.0	29.8	14.4	0.7	100	

Table.2. shows that the motorcycle was responsible for the highest number of RTI- related injuries (50.6%) and the motorcyclist was most affected by the RTI-related injuries. The motorcycle was also responsible for the highest number of passengers that suffered OMFIs.



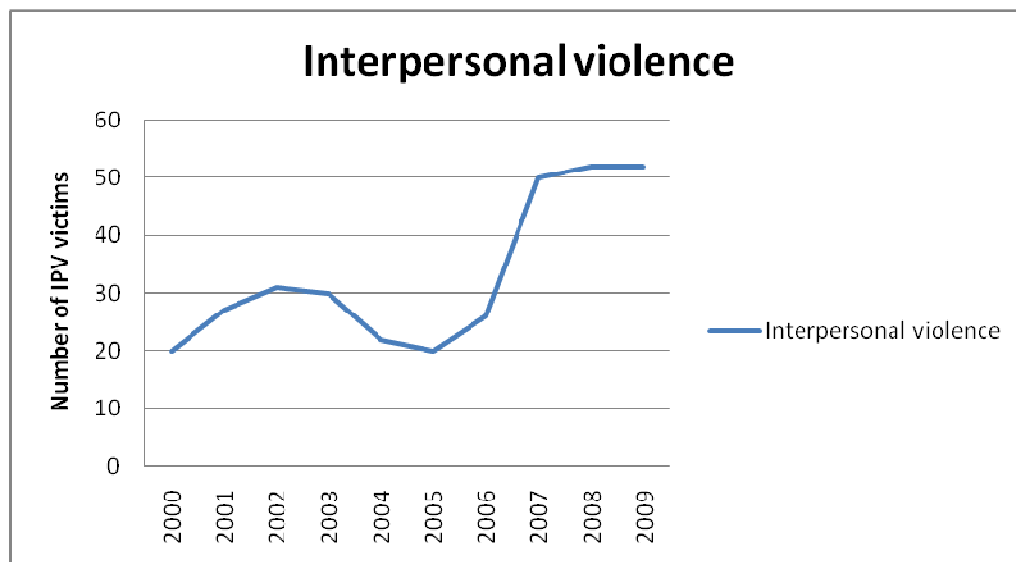
**Fig. 3: Yearly distribution of RTI-related OMFIs versus aetiology.**

Fig.3. shows the trend of OMFIs due to RTI- related aetiological factors over the ten-year period. The trend of motorcycle injury-victims shows a much steeper rise as compared to victims of other RTI- aetiological factors . The rise of MCA-related injuries was exponential between 2006 and 2009. Other RTI- related aetiological factors showed more fluctuating trends with smaller magnitudes of rise .

**Table 3: Distribution of IPV-related injuries according to gender (n=332), P=0.000).**

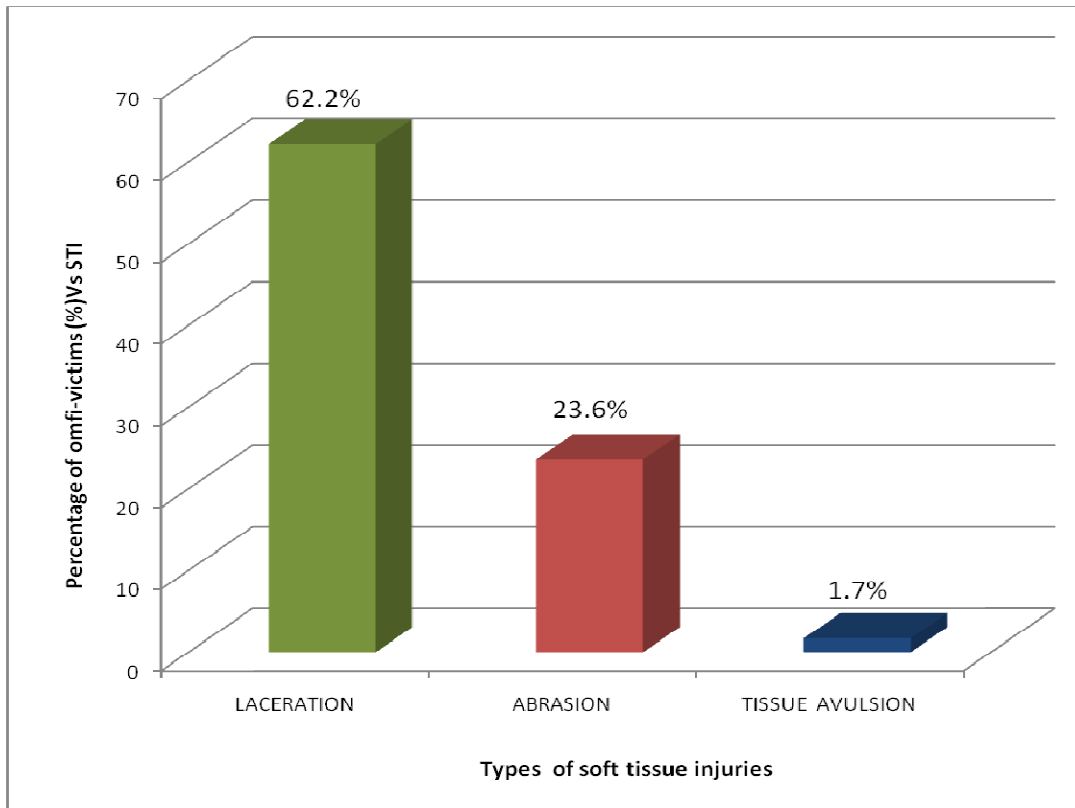
IPV	Female	Male	Total	Percentage (%)
Domestic	13	5	18	5.4
Non-domestic	22	285	307	92.3
Child abuse	0	2	2	0.6
Human bite	2	3	5	1.5
Total	37	295	332	
Percentage (%)	11.1	88.9		100

The IPV-related injuries affected mainly the male gender (88.9%) most of them being due to non-domestic violence (92.3%). More females were affected by domestic violence than males. The difference between male and female was statistically significant ( $p < 0.05$ ).



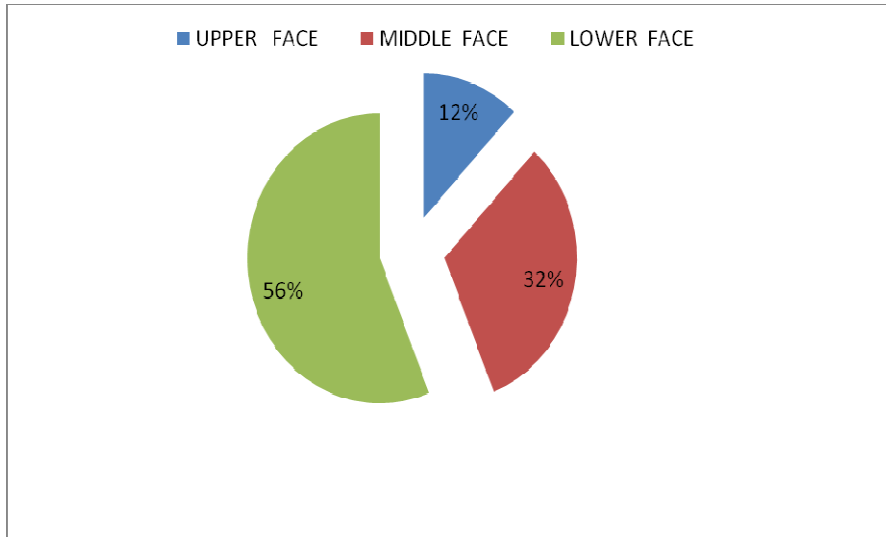
**Fig. 4: Number of IPV victims according to years**

Interpersonal violence showed a general rising trend over the ten years, with a steep rise between 2005 and 2007.



**Fig. 5: Soft tissue injuries**

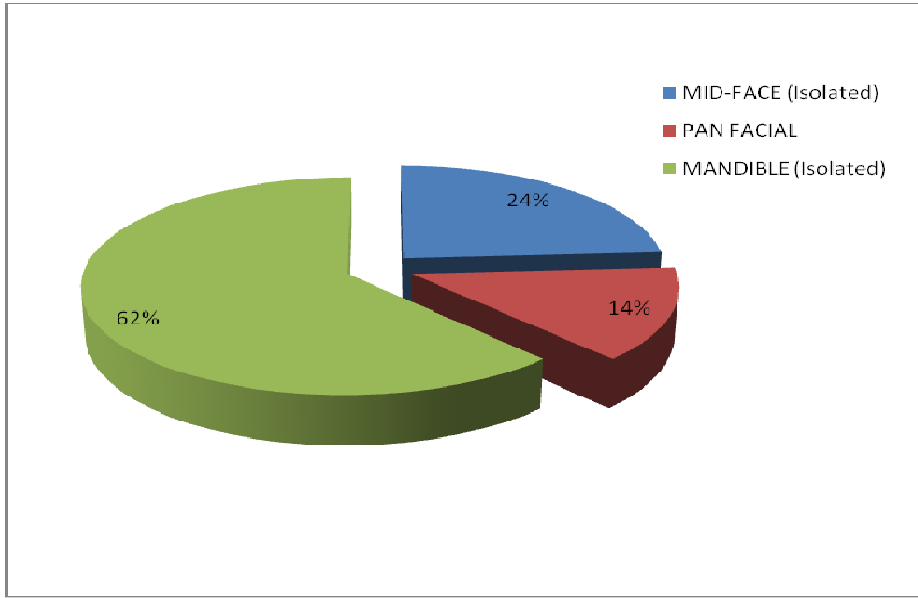
Fig.5 shows that 62.2% of the total number of OMFI- victims sustained soft tissue lacerations. This was numerically followed by abrasions, the least pattern of soft tissue injury being avulsions.



**Fig.6: Distribution of facial injuries by anatomical site.**

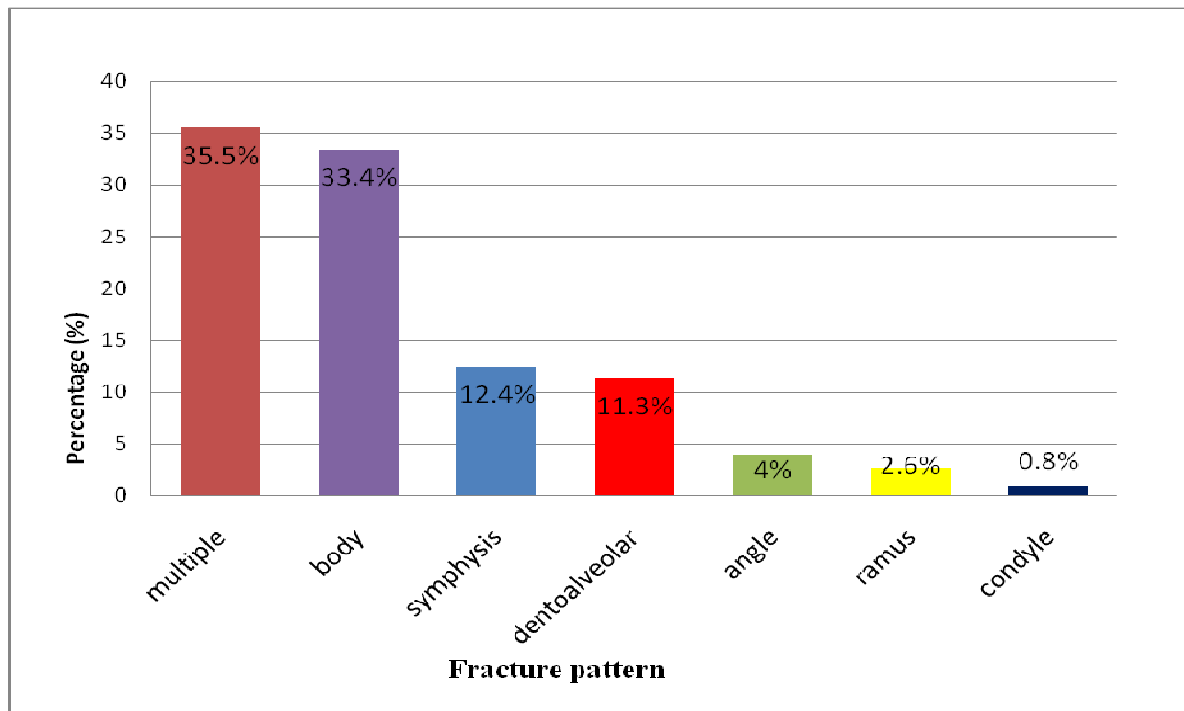
Fig.6 shows that anatomically the lower section of the face was the most affected by OMFIs while the upper face was least affected.





**Fig.7: Fracture distribution over the facial skeleton**

More OMFI victims sustained isolated mandibular fractures, whereas there was no recorded isolated fracture of the frontal bone.



**Fig.8: Anatomical distribution of mandibular fractures.**

The fractures of the mandible mostly presented a multiple pattern (35.5%), with two or more different parts of the mandible being involved. Single isolated fractures mainly involved the body (33.4%), whereas isolated fractures of the condyle were the least recorded (0.8%).

**Table 4: Pattern of mandibular fractures according to aetiology (n=663).**

	MCA	MVA	O- RTA	FAI	IPV	Sport	Fall	Animal	Others	Total	(%)
<b>Condyle</b>	1	2	1	1	0	0	1	0	0	6	0.9
<b>Ramus</b>	3	3	0	2	6	0	2	0	0	16	2.4
<b>Angle</b>	7	9	2	0	8	0	1	0	2	29	4.4
<b>Body</b>	57	48	11	8	76	1	9	3	5	218	32.9
<b>Symphysis</b>	25	25	8	1	16	0	6	1	1	83	12.5
<b>Dental alveolar</b>	28	15	9	2	14	0	7	0	2	77	11.6
<b>Multiple</b>	61	50	12	10	95	0	4	1	1	234	35.3
<b>Total</b>	182	152	43	24	215	1	30	5	11	663	100
<b>(%)</b>	27.5	22.9	6.5	3.6	32.4	0.2	4.5	0.8	1.7		

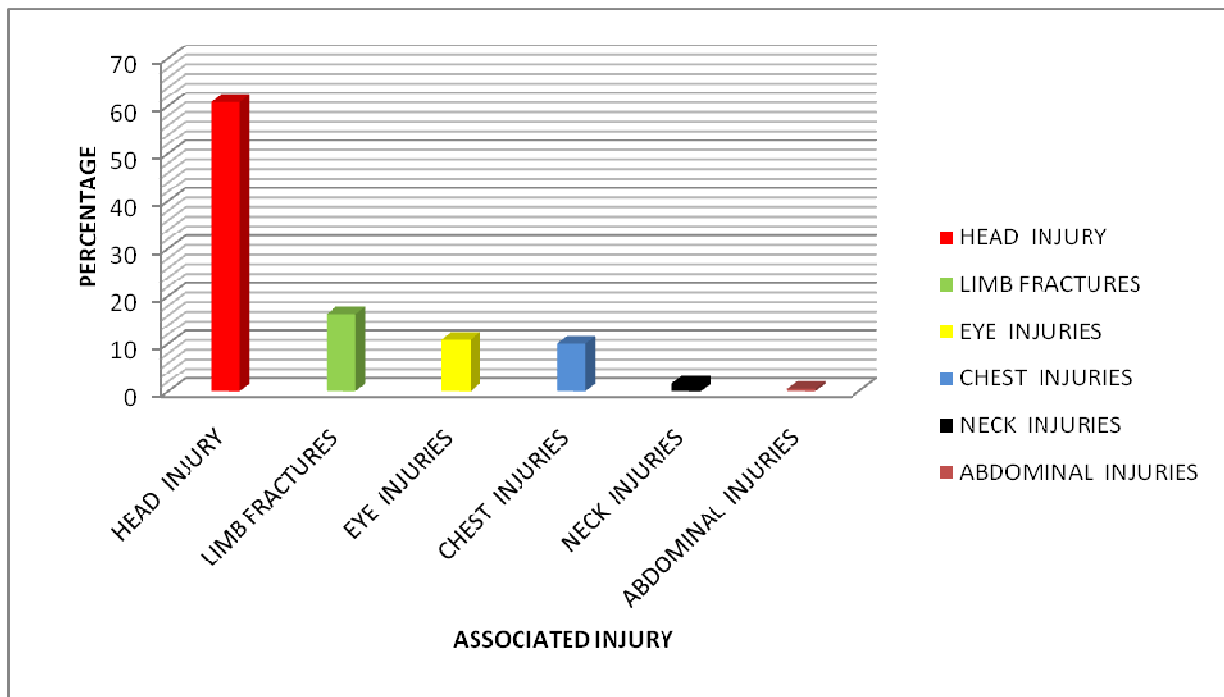
The mandibular fractures mainly presented in multiple pattern (35.3%), and this pattern of injury was mainly due to IPV (n=95). Among the isolated fractures, the body of mandible (32.9%) were most prevalent, and the main aetiological factor was IPV (n= 76). The condylar fractures (0.9%) were least registered. The single most aetiological agent of mandibular fractures was the IPV (32.4%), followed by the motorcycle (27.5%). There was a significant correlation between mandibular fractures and IPV, (Pearson correlation coefficient-  $R = 0.116$ ,  $P < 0.05$ ). There was no significant correlation between mandibular fractures and MCAs, however, R was significant

for MVAs, at  $R= 0.068$ ,  $p = 0.019$ . In general RTIs (MCAs, MVAs and O-RTAs) were the most aetiological factors of mandibular fractures being responsible for a total of 56.9% of them.

**Table 5: Pattern of mid-face fractures according to aetiology (n=388).**

	MVA	MCA	O- RTA	IPV	Fall	FAI	Sport	Animal	Others	Total	(%)
<b>Nasal fractures</b>	6	11	3	1	1	0	0	2	1	25	6.4
<b>Zygomatic fractures</b>	20	50	12	30	1	1	7	3	2	126	32.5
<b>LE Forte 1</b>	17	27	2	0	0	1	0	0	0	47	12.1
<b>LE Forte 11</b>	11	26	5	0	2	1	0	0	2	47	12.1
<b>LE Forte 111</b>	0	2	0	0	0	0	0	0	0	2	0.5
<b>Dental Alveolar</b>	36	49	17	19	12	2	1	2	3	141	36.3
<b>Total</b>	90	165	39	50	16	5	8	7	8	388	100
<b>(%)</b>	23.2	42.5	10.1	12.9	4.1	1.3	2.1	1.8	2.1		

Motorcycle accidents (MCAs) were responsible for the highest percentage(42.5%) of injuries in the mid-facial region, followed by motor vehicle accidents (MVAs) and IPV respectively. Most of the mid-face injuries presented as dental alveolar fractures ( 36.3%) followed by zygomatic fractures (32.5%). The least injury of the mid-face recorded was le forte 111 fracture. There was a positive correlation between MCAs and mid-face fractures ; Pearson correlation coefficient (R)= 0.168, P < 0.05.



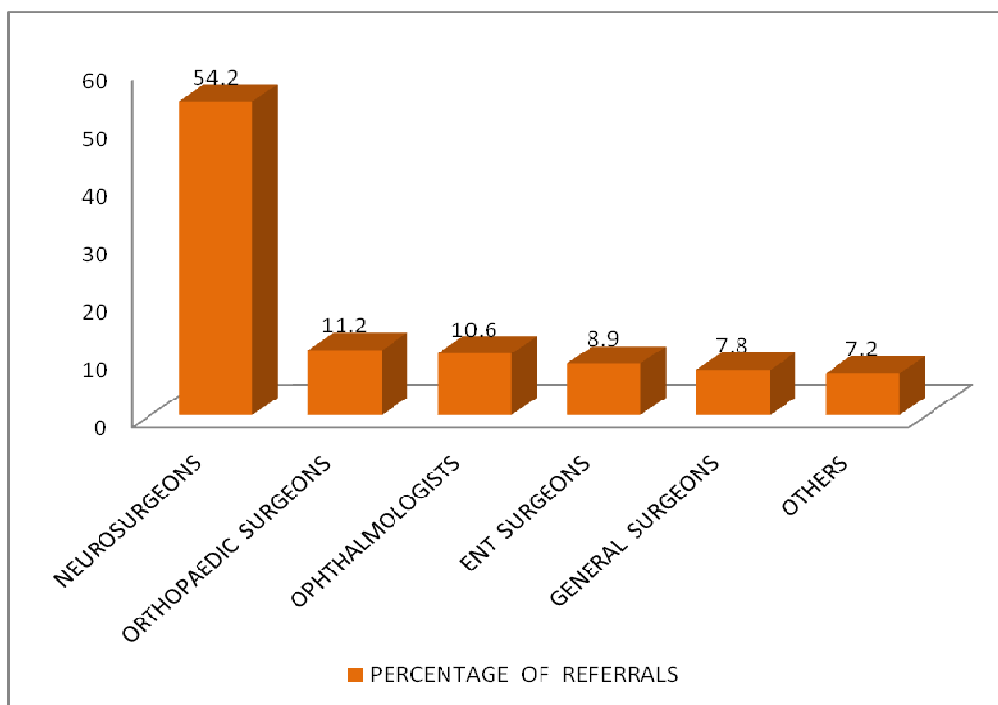
**Fig.9: Distribution of other injuries associated with OMFIs.**

Fig.9 shows that the injury most associated with OMFIs in this study was head injury followed by limb fractures, eye injuries and others respectively.

**Table 6: Imaging modalities (n=913).**

<b>Imaging</b>	<b>No. of patients</b>	<b>Percentage (%)</b>
<b>Plain radiography</b>	892	97.7
<b>CT-scan</b>	18	2
<b>Brain echo</b>	3	0.3
<b>Total</b>	913	100

Table 6 shows that majority of patients who required imaging for diagnostic purposes underwent plain radiography (97.7%), whereas very few patients underwent CT-scanning or any other form of imaging.



**Fig.10: Referral to specialists.**

Most of the referrals were made to neurosurgeons; n=256 (54.2%) followed by orthopaedic surgeons; n=53 (11.2%). The “OTHERS” category included specialists like dentists and prosthodontists who took part in the definitive treatment of the victims and those received the least number of referrals; n=34 (7.2%).

**Table7: Definitive management of patients (n=1622).**

<b>Definitive Treatment</b>	<b>No.of procedures</b>	<b>Percentage (%) out of 1203</b>
Soft tissue repair	727	60.4
Open reduction & internal fixation (ORIF).	48	4.0
Closed reduction (intermaxillary fixation with eyelets or arch bars.	559	46.5
Arch bar-wiring for dentoalveolar fractures	172	14.3
Other forms of management.	116	9.6
<b>TOTAL</b>	<b>1622</b>	<b>134.8</b>

Out of the total number of victims 60.4% (n=727) underwent soft tissue repairs. For skeletal fractures 46.5% underwent closed reduction whereas 4.0% (n=48) underwent open reduction and internal fixation (ORIF). About 10% (n=116) of the patients underwent other forms of definitive management like extraction of fractured retained roots and prosthetic management.

## CHAPTER SIX

### 6.1 Discussion

OMFIs affect a significant number of trauma patients and consequences of trauma to this region can include any combination of dental, bone, or soft tissue injury. The gender distribution in this study was consistent with that found in other studies where a higher frequency of OMFIs among males compared to females was noted.<sup>5,7,10,12,14,15</sup>

The M:F ratio of 4.6:1 was comparatively lower than what was observed in a previous study done on maxillofacial fractures at the same unit where the male: female ratio was found to be 7.7:1 in a population of 132 patients.<sup>5</sup> The difference in male to female ratio observed in this study compared to the previous study at the same unit could have been due to the difference in research methodology and should be a subject of more research. In a Malaysian study on OMFIs



by Hussain et al. the ratio of male: female was found to be 3.8: 1 which was much closer to the findings of this study.<sup>10</sup> Literature from different regions of the world shows varying ratios of male: female but the males are consistently seen to be more affected by OMFIs in all the studies. The higher male proportionality may be attributed to the fact that men are more involved in high risk behaviours.

Most of the victims of OMFIs in were young men in the 20-30-year-old age-group (41%), similar observations were made in several other studies. In a Kenyan study (Mwaniki DL and Guthua SW .1990).<sup>14</sup> Lahore- Pakistan study ( Saeed A C et al. 2006) <sup>11</sup> and a study done in United Kingdom ( Chege E. 2007)<sup>18</sup> all showed that this age-group was the most prone to OMFIs. The high incidence of OMFIs among this age- group could possibly be due to the fact that this age-group is very energetic, takes part in high-risk exercises and sports. They are also most likely to flout road traffic regulations as well as get involved in violent acts making them more prone to sustaining these injuries.<sup>6,42</sup>

In general RTIs were responsible for the highest number of OMFIs followed by IPV. The MCAs were responsible for the biggest percentage of the RTI-related OMFIs. It was also observed that among the RTI-related OMFIs the motorcyclist was the most affected. Fig.3 shows an exponential rise in the trend of motorcycle-related OMFIs from the year 2006 to 2009. These findings were in agreement with those of the previous Ugandan study which showed that 66.21% of the RTIs were due to motorcycle accidents and 77.55% of motorcycle-related injuries affected the riders.<sup>5</sup> The observed trend of MCAs could have been as a result of more young men acquiring motorcycles for commercial purposes over the years, or due to more of the urban population turning to the motorcycle as an alternative means of cheaper transport and one that could easily circumvent the ever increasing traffic jam on the roads of a number of urban centres.

These observations were also comparable to study findings from Malaysia where RTIs were responsible for 73% of OMFIs and motorcycle injuries accounted for 60% of the RTIs.<sup>10</sup> In a Nigerian study it was observed that 72% of the OMFIs sustained by their study population were due to RTIs.<sup>3</sup> In Kenya where earlier studies had shown that IPV was the major aetiological factor of OMFIs RTIs were seen to be on the rise by subsequent studies.<sup>9</sup> In developing countries the motorcycle seems to have gradually taken position as one of the most favorable means of public transport, hence its association with the highest number of RTI-related OMFIs. The bicycle as another form of aetiological factor for RTI-related OMFIs was responsible for 8.2% of all the OMFIs and 13.5% of RTI-related OMFIs recorded in this study. Most road traffic regulations tend not to address non- motorized forms of transport on the roads yet from this study they contributed substantially to RTI-related OMFIs. This points to a necessity of incorporating regulations for non- motorized forms of transport in road traffic rules.

The World Health Organization (WHO) has estimated that nearly 25% of all injury fatalities worldwide are as a result of road traffic crashes, with 90% of the fatalities occurring in the low and middle-income countries mainly found in Sub-Saharan Africa.<sup>43</sup>

The interpersonal violence (IPV) was second to RTIs as an aetiological factor of the OMFIs in this study. The findings of the present study on IPV compared well with findings of a previous Ugandan study done at the same surgical unit where 25% of jaw fractures were found to be due to IPV.<sup>5</sup> Studies done in Kenya<sup>14</sup> , Zimbabwe<sup>15</sup> and other studies done in developed countries<sup>12</sup>, showed that IPV was the main aetiological factor of OMFIs. IPV often reflects peoples' way of social life and psychological stress levels in a community. Use of alcohol and abuse of narcotic drugs are a major factor in the increase of IPV especially in developed countries.<sup>12</sup> The male gender as observed in this study was more affected by IPV due to non-

domestic causes. This could have possibly been due to males being more involved in activities outside the home either fending for their families or socializing. The male gender also tends to be more aggressive in nature and this could have possibly contributed to their being more affected by IPV.

Injury patterns were largely dependent on the aetiology and from this study the lower part of the face was most involved followed by the mid-face and upper part of the face respectively. Different studies have come up with different prevalence of distribution of facial injuries, however, findings of the present study concurred with what was observed in a previous Ugandan study where the lower face incurred 66% of the injuries and a Lahore- Pakistan study where 67% of the maxillofacial fractures involved the mandible<sup>5, 11</sup>. In those studies a statistical significance between aetiology and distribution of facial injuries was observed and like in the present study MCAs were the main aetiological factor. Most fractures of the mandible were multiple in nature, however, the most prevalent isolated fracture of the mandible involved the body. The aetiological factor that caused the highest number of mandibular body fractures was IPV followed by MCAs but in general RTIs were the most aetiological factors in mandibular fractures. Studies done in Malaysia, Nigeria and Brazil have shown that fracture distribution of the mandible is related to aetiology where RTIs are commonly associated with symphyseal and condylar fractures whereas IPV mainly affects the body and the angle.<sup>10,37,45</sup> Findings of this study were in agreement with the observations made in those studies because it was found that IPV was responsible for most of the mandibular fractures involving the body whereas RTI was mainly associated with fractures involving the rest of mandibular parts.

Like in the previous Ugandan study,<sup>5</sup> the maxilla was found to be the most affected bone in the mid-facial region, however, studies from elsewhere have reported the zygoma to be the most affected by OMFIs in the mid-face region.<sup>3, 6.</sup>

The pattern of soft tissue injuries (STIs) varied according to aetiology. Whereas STIs due to fire arm injuries and biting animals were avulsive in nature those from RTIs presented mainly as lacerations and abrasions. Similar observations were made from studies done in Kenya; (Odhiambo et al. 2008), (Guthua et al. 1999) and Nigeria (Ugboko et al. 2002).<sup>21,32,31</sup>

Head injury was found to be the most associated with OMFIs of all injuries affecting the rest of the body. This was followed in magnitude by limb fractures, eye and chest injuries respectively. This compared positively with findings of a Kenyan study by Akama et al. where it was found that 15-45% of head injuries were associated with OMFIs.<sup>9</sup> The prevalence of head injury may possibly have been due to anatomical proximity of the two areas and in a number of trauma cases the extent of OMFIs may act as a marker for head injury and its severity.<sup>45</sup> The magnitude of head injury as compared to other associated injuries in this study was reflected by the number of referrals made to neurosurgeons.

The diagnostic imaging modality utilised at the Oral and Jaw injuries Unit of MNRH was mainly plain radiography. This included orthopantomograms, sub mental vertex, occipital mental and other views. Few Computerised tomogram scans were registered. From the records we could not establish whether plain radiography was a matter of choice or convenience for either the management team or the patients due to cost implications.

A high number of patients underwent soft tissue repair mainly due to lacerations and a few soft tissue avulsions. This was comparable to the findings of a Nigerian study by Ugboko et al. where

62.2% of the victims were treated for soft tissue injuries.<sup>3</sup> The soft tissues are always the first to absorb any external force to the body hence the magnitude of STIs observed.

A big proportion of skeletal injuries were managed by means of closed reduction which included intermaxillary fixation with eyelet wires and arch bar splinting. A previous Ugandan study reported 90.15% of maxillofacial fractures having been managed by means of closed reduction.<sup>5</sup> A similar situation was reported in a Nigerian study where 98% of mandibular and 70.1% of zygomatic fractures were managed by closed reduction.<sup>3</sup> In this study few patients were managed by means of ORIF which included use of plates and screws while in some cases wire osteosynthesis was done. In comparison to the developed world, most facial fractures are managed by ORIF.<sup>47, 48</sup>

#### **Study limitations:**

- (a) The study was based on patient-files kept within the Oral and Jaw injuries unit of MNRH; it was not possible to verify whether some files of poly-trauma patients were retained in other surgical departments.
- (b) The accuracy of the information gathered by the research team was dependent on the quality of the clinical information in the patient- files.
- (c) Mortality files were not readily accessible due to separate storage and archival of older files

#### **6.2 Conclusion**

- According to this study OMFIs affected mostly young males between 20 and 30years of age.

- The main aetiological factors were RTIs especially motorcycle accidents followed by IPV. Mandibular fractures were mostly attributed to IPV whereas mid face fractures were mostly due to MCAs.
- The trend of OMFIs especially due to MCAs was on the rise over the 10 -year period. The mandible was found to be the most affected by OMFIs, whereas the most frequent associated injury was head injury.
- The diagnostic imaging modality utilised at the Oral and jaw injuries unit of MNRH was mainly plain radiography.
- It was also observed that skeletal injuries were commonly managed by closed reduction.

### **6.3 Recommendations**

- Since most of these injuries were caused by road traffic injuries especially motorcycle accidents (MCAs), preventive measures to minimise their occurrence need to be put in place and enforced. These measures should target a particular segment of society mostly affected by these injuries and may include proper training of motorcycle riders and education of the public on observation of road traffic regulations.
- Prospective studies on the main aetiologies of OMFIs like RTIs and IPV need to be done so as to establish their route causes, and devise means of reducing their incidences.

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## APPENDICES

### Appendix I: Data collection instrument

#### Bio data

A. Patient hospital Number.....

B. Characteristics

B1. Age in years.....

B2. Gender

1- Female       2- Male

B 3. District .....

B4. Date of injury.....

**C. Cause of injury**

**C1. RTA**

C1a. Motor-vehicle

1-Yes       2-No       3-Not applicable

C1b. Motorcycle

1-Yes       2-No       3-Not applicable

C1c. Other RTA

1-Yes  2-No  3-Not applicable

If 2 or 3 skip to C1e.....

.....

C1d. Other RTA, specify.....

C1e. Victim:

1- Passenger

2- Pedestrian

3- Motorist

4- Motorcyclist

5- Bicycle Rider

6- Other

**C2. FAI-Fire arm injury**

1-Yes  2-No  3-Not applicable

**C3. IPV-Interpersonal violence**

1- Domestic

2-Non-domestic

3-Child abuse

4-Human bite.

**C4. Falling**

1-Yes  2-No  3-Not applicable


**C5. Sports Injury**

1-Yes  2-No  3-Not applicable

**C6. Animal attack:**

1-Domestic

2-Wild

3- Not Applicable  **Skip to C7a.**

**6a. Bitten**

1-Yes  2-No  3-Not applicable

**6b. Mauled**

1-Yes  2-No  3-Not applicable

**6c. Crushed**

1-Yes  2-No  3-Not applicable

**C7a. Others causes of Injury.**

1-Yes  2-No  3-Not applicable  → **If 2 or 3 Skip to D1**

**.C7b. Other causes of Injury specify.....**

**D. Substance abuse within 4 hours before injury:**

D1. Alcohol

1-Yes  2-No  3-Not applicable

D2. Drugs

1-Yes  2-No  3-Not applicable

**E. Anatomical site of Oral maxillofacial region involved:**

E1. Upper face (UF)

1-Yes  2-No  3-Not applicable

E2. Mid face (MF)

1-Yes  2-No  3-Not applicable

E3. Lower face (LF)

1-Yes  2-No  3-Not applicable



**F. Type Of Injury Sustained:**

F1. Soft tissue injury:

1-Yes  2-No  3-Not applicable

F1a. Laceration

1-Yes  2-No  3-Not applicable

F1b. Abrasion

1-Yes  2-No  3-Not applicable

F1c. Tissue avulsions

1-Yes  2-No  3-Not applicable

F2. Skeletal Injury (Facial bones):

F2a. Frontal bone

1-Yes  2-No  3-Not applicable

F2b. Nasal bones (isolated).

1-Yes  2-No  3-Not applicable

F2c. Zygomatic bone (isolated).

1-Yes  2-No  3-Not applicable

F2d. Mid-facial:

- 1. Le forte I
- 2. Le forte II
- 3. Le forte III
- 4. Dent alveolar

F2e. Mandible:

- 1. Condyle
- 2. Ramus
- 3. Angle
- 4. Body
- 5. Symphysis
- 6. Dento-alveolar
- 7. Multiple

F3. Teeth involvement:

F3a. Fractures

- 1-Yes     2-No     3-Not applicable

F3b. Avulsions

1-Yes  2-No  3-Not applicable

F3c. Mobile

1-Yes  2-No  3-Not applicable

F4. Involvement of vital structures:

F4a. Major nerves

1-Yes  2-No  3-Not applicable

F4b. Major blood vessels

1-Yes  2-No  3-Not applicable

F4c. Salivary glands

1-Yes  2-No  3-Not applicable

**G. Associated Injuries:**

G1. Head injury

1-Yes  2-No  3-Not applicable

G2. Neck injuries...

1-Yes  2-No  3-Not applicable

G3. Eye injuries.

1-Yes  2-No  3-Not applicable

G4. Chest injuries

1-Yes  2-No  3-Not applicable

G5. Abdominal injuries

1-Yes  2-No  3-Not applicable

G6. Limb fractures

1-Yes  2-No  3-Not applicable

G7. Injury to any other vital organ

1-Yes  2-No  3-Not applicable

**H. Imaging:**

H1. Plain radiography

1-Yes  2-No  3-Not applicable

H2. CT-Scan

1-Yes  2-No  3-Not applicable

H3. MRI

1-Yes  2-No  3-Not applicable

H4. Other Investigations done

1-Yes  2-No  3-Not applicable

H5. Other Investigations done, Specify.....

**J. Immediate Treatment.**

J1. Tetanus toxoid

1-Yes  2-No  3-Not applicable

J2. Antibiotics and Analgesics

1-Yes  2-No  3-Not applicable

J3. Others immediate treatment

1-Yes  2-No  3-Not applicable  → **If 2 or 3 skip to KI**

J4. Other Immediate treatment, specify.....

**K Consultation:**

K1. Ophthalmologist

1-Yes  2-No  3-Not applicable

K2. ENT- Surgeon

1-Yes  2-No  3-Not applicable

K3. Neurosurgeon

1-Yes  2-No  3-Not applicable

K4. General surgeon

1-Yes  2-No  3-Not applicable

K5. Orthopaedic surgeon

1-Yes  2-No  3-Not applicable

K6. Others

1-Yes  2-No  3-Not applicable

**L. Definitive Management:**

1-Yes  2-No  3-Not applicable  $\longrightarrow$  If 2 or 3 Skip to M

L1. Soft tissue repair

1-Yes  2-No  3-Not applicable

L2. Open reduction and internal fixation

1-Yes  2-No  3-Not applicable

L3. Inter-maxillary fixation with eyelet wiring

1-Yes  2-No  3-Not applicable

L4. Splinting with arch bar.

1-Yes  2-No  3-Not applicable

L5. Other definitive management

1-Yes  2-No  3-Not applicable  → **If 2 or 3 skip to M**

L6. Other definitive management, specify.....

**M. Conservative management**

1-Yes  2-No  3-Not applicable

**N. Attending Personnel:**

N1. Intern doctor

1-Yes  2-No  3-Not applicable

N2. Dental surgeon

1-Yes  2-No  3-Not applicable

N3. Maxillofacial surgeon

1-Yes  2-No  3-Not applicable

N4. Other attending personnel

1-Yes  2-No  3-Not applicable

N5. Other attending personnel specify.....