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Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

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Abstract

Background: The mandible is one of the most commonly fractured bones of the facial skeleton because of its anatomical prominence.

Objective: The objective of the study was to establish the etiological factors and pattern of mandibular fractures among patients (n=73) aged 3 – 55 years attending the Oral and Maxillofacial Surgery Unit of Mulago Hospital.

Methods: This was a hospital based cross-sectional study among patients with mandibular fractures who were consecutively recruited after informed consent. The data were collected using a structured questionnaire and clinical oral examination. The collected data were analyzed using Statistical Package for Social Sciences, version 17 for Windows, Chicago, Illinois, USA.

Results: There were 73 patients with 107 mandibular fracture sites. Most fractures were caused by road traffic accident (58%) and assault (38%), and especially among pedestrians and passengers. About half of the patients with fractures were aged 21-30 years. The sex ratio of the patients was 7.7 males versus 1 female. About 17% of the patients were under the influence of alcohol during injury. Majority (69.9%) of the injuries occurred in the Kampala Metropolitan area. Single fractures were observed in 55% of the patients and half of them, displaced. About 91% of the patients with multiple fractures were bilateral. **Conclusions:** The present study indicated that road traffic accidents and assaults were major causes of mandibular fractures, particularly among the youths in the studied population. Males were more prone to mandibular fractures.

Keywords: assaults, pedestrians, mandibular fractures, road traffic accidents

INTRODUCTION

The mandible (lower jaw) is the largest and strongest bone of the face. It houses the lower teeth and plays a role in mastication, respiration, speaking, swallowing and facial aesthetics. It consists of a curved or horse shoe shaped horizontal body, and two perpendicular rami, which unite with the two ends of the body almost at right angles¹. The mandible is an anatomically

prominent and mobile component of the facial skeleton that is the most commonly fractured bone of the face^{2,3}. The various mandibular fracture patterns (types) are based on anatomic sites,³⁻⁵ which include: alveolar ridge (process), symphysis, parasymphysis, body, angle, ramus, condyle, and coronoid³ (Table 1). Some of the mandibular fractures are either single/multiple or unilateral/bilateral,^{6,7} comminuted or displaced in nature^{8,9}.

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

Table 1. Classification of mandibular fractures according to anatomic site of the bone¹

Anatomic site	Description of fracture
Alveolar ridge	Limited to the tooth bearing area of the mandible without disrupting the continuity of the underlying osseous structure
Symphysis	Occurs in the region of the incisors running from the alveolar ridge through the inferior boarder of the mandible
Parasymphysis	Occurs between the mental foramen and the distal aspect of the lateral incisor extending from alveolar ridge through the inferior boarder
Body	Occurs in region between the mental foramen and the distal portion of the second molar, exceeding from the alveolar ridge through the inferior boarder.
Angle	Occurs distal to the second molar, extending from any point on the curve formed by the junction of the body and ramus in the retro molar area to any point on the curve formed by the inferior boarder of the body and the posterior boarder of the ramus
Ramus	One with fracture line that extends horizontally through the anterior and posterior boarders of the ramus vertically from the sigmoid notch to the inferior boarder of the mandible
Condyle	Fracture runs from the sigmoid notch to the posterior boarder of the ramus of the mandible along the superior aspect of the ramus

Khan et al.¹⁰ noted that the fracture site of the mandible depends on the magnitude and direction of the impact force. They indicated that the mandible tends to fracture at the site of high tensile strain and is more sensitive to lateral impact especially at the body and ramus. The frequency of mandibular fractures increased with age, exacerbated by atrophy. Apart from age, presence of teeth in the mandible and the magnitude of the force had direct effect on the characteristics of the resulting fracture¹⁰.

Previous surveys¹¹⁻¹³ on mandibular fractures showed that the etiology varies from one country to another and within the same country depending on prevailing socio-economic, cultural, religious and environmental factors as well as time of the day. The most common etiological factors are road traffic accidents (RTA), falls, gunshots, sporting activities and industrial accidents¹⁴. Generally, assault is the predominant cause of maxillofacial fractures in developed countries while motor vehicle accidents are the most prevalent in developing countries^{15,16}.

In Uganda, Kamulegeya et al.¹⁷ reported 68.9% of isolated mandibular fractures among patients with maxillofacial fractures who attended Mulago Hospital. More than half of the mandibular fractures were due to RTA. The male to female ratio was 7.7:1 and the 21-30 year age group was most affected. The fracture pattern of the mandible was either single or multiple and unilateral or bilateral with or without displacement or comminution. Although, Kamulegeya et al.¹⁷ gave baseline data on mandibular fractures in

Mulago Hospital, they did not report on some of the fracture sites, indicative of limited information, hence the purpose of the present study to elaborate more on the subject.

METHODOLOGY

Study Design

This was a descriptive cross sectional study based on consecutive recruitment of participants.

Study setting

The study was carried out at Oral and Maxillofacial Surgery (OMFS) unit in Mulago Hospital. The hospital is a national referral and teaching hospital located in Kampala, the capital city of Uganda. It has several outpatient clinics and wards with more than 1500 bed capacity. The OMFS unit has an outpatient clinic and a 22 bed ward. It has a team of various categories of oral health workers including Oral and Maxillofacial Surgeons, a Radiologist, Senior House Officers, Dental Surgeons, Interns and Nurses. Maxillofacial patients are routinely received through the hospital Causality Department and depending on their condition, they are sent either to the outpatients' clinic or the ward for appropriate management.

Study population

The study participants comprised of male and female patients aged 3 – 55 years with mandibular fractures, consecutively selected from all newly registered patients attending the OMFS clinic in Mulago Hospital.

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

Inclusion criteria

All newly registered patients with mandibular fractures due to trauma.

Exclusion criteria

Patients with mandibular fractures who on their own or attendants could not recall the history or circumstances of the injury.

Selection of study participants

The sample size (n=73) was determined based on the estimated 5% prevalence of mandibular fractures from medical records in OMFS unit in Mulago Hospital (Mpiima 2016, unpublished) and using Kish¹⁸ formular. The patients with mandibular fractures who met the inclusion criteria were consecutively recruited after written informed consent.

Data collection

The demographic information: aetiological and risk factors associated with mandibular fractures were recorded using a structured questionnaire through an oral interview of the patient/parent/guardian and review of medical records. The pattern of mandibular fractures was recorded through clinical oral examination of the patient by the Principal Investigator (PM). Radiographs that were routinely requested by the attending surgeons were used to confirm the pattern of mandibular fractures with help of an Oral and Maxillofacial Radiologist (Kate Kabenge).

QUALITY CONTROL

The clinical examiner (PM) was a trained dentist previously calibrated in recording mandibular fractures by a Consultant Oral and Maxillofacial Surgeon (Francis Lakor). The filled data collection forms were double checked for errors and completeness before the patient was dismissed. The data were entered into computer and double checked for errors and completeness.

Data management and analysis

The data were entered into computer and analyzed using Statistical Package for Social Sciences (SPSS) Inc. version 17 for windows, Chicago, Illinois, USA. Descriptive statistics were used to summarize the data and presented in tables.

Ethical consideration

The study was approved by Makerere University School of Health Sciences Research and Ethics Review Board, Mulago Hospital Research and Ethics Committee and Uganda National Council of Science and Technology. The patients who were 18 years and above were requested for written informed consent in accordance with Helsinki Declaration¹⁹. For patients aged between 12 and 17 years, were requested for assent in addition to the consent from their parents or guardians, while those below 12 years, had their informed consent obtained from parents or guardians. A local language (Luganda) version of consent form was used for the patients/guardians who did not understand English. In the event that one was illiterate, s/he was requested to thumb print after an explanation to her/him what the study was all about. The information obtained from the participants was kept confidential apart from sharing it with the attending health care providers. There were no personal identifiers of the patients like names during data collection and the findings remained anonymous.

RESULTS

Demographic characteristics of patients with mandibular fractures

Majority (88%) of the patients were males (Table 2). Most patients (48%, n= 35) were in the 21-30 year age group while 28.8% were aged \leq 20 years Table 2). Majority (44%) of the patients had attained secondary level education and only 1% had informal education. Most patients with mandibular fractures were pedestrians (39.7%) and motor cyclists (23%; Table 2). The majority (38%) of the patients had fractures between 9.01 pm and 5.59 am. About 53.6% (n=15) of the patients who got injuries between 9:01 pm and 5:59 pm was due to assault.

Aetiological and risk factors of mandibular fractures

Road traffic accidents (57.5%) and assault (38.4%) were the most common causes of mandibular fractures (Table 2). Majority of the patients (85%, n=62) attained the mandibular fractures from the central region (Table 2) and Kampala Metropolitan area alone (Kampala, Wakiso and Mukono) had

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

69.86 % (n=51; Table 2) of the burden. In Northern region, the 3 patients with mandibular fractures were respectively, due to RTA, gunshot and assault (Table 2). In Eastern region, the 2 patients with mandibular fractures were due to RTA (Tables 1&2) and in Southern region, no patient was observed. About 19% (n=14) of the patients reported substance abuse,

particularly alcohol (Table 2). Most patients (83.3%) who abused alcohol sustained mandibular fractures following assault. The patient who abused khat got the fracture in RTA unlike the marijuana counterpart, due to assault. One patient had seizures at the time of the injury and due to RTA (Table 2).

Table 2. The frequency distribution of patients with mandibular fractures according to demographic factors and cause of injury (n=73)

Demographic factor		Cause of injury				
		RTA n (%)	Sports activity n (%)	Gunshot n(%)	Fall n(%)	Assault n (%)
Sex	Male	35(54.0)	1(1.5)	1(1.5)	1(1.5)	26(40.7)
	Female	7(77.8)	0 (0.0)	0 (0.0)	0 (0.0)	2(22.2)
Age (Years)	≤ 20	13(61.90)	1(4.76)	0 (0.0)	1(4.76)	6(28.57)
	21- 30	18(51.43)	0 (0.0)	0 (0.0)	0 (0.0)	17(48.57)
	> 30	11(64.70)	0 (0.0)	1(5.88)	0 (0.0)	5(29.41)
Educational level	Informal	1(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Primary	19(73.07)	0 (0.0)	0 (0.0)	1(3.85)	6(23.08)
	Secondary	16(50)	1(3.13)	1(3.13)	0 (0.0)	14(43.75)
	Tertiary	6(42.86)	0 (0.0)	0 (0.0)	0 (0.0)	8(57.14)
Substance abuse (n=14)	Alcohol	2(16.70)	0 (0.0)	0 (0.0)	0 (0.0)	10(83.30)
	Marijuana	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1(100)
	Khat	1(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Role of participant at time of injury	Pedestrian	8(27.59)	0 (0.0)	0 (0.0)	0 (0.0)	21(72.41)
	Passenger	17(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Motorcyclist	13(76.47)	0 (0.0)	0 (0.0)	0 (0.0)	4(23.53)
	Bicyclist	3(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Driver	1(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Other	0 (0.0)	1(16.67)	1(16.67)	1(16.67)	3(50)
Time of attainment of injury	6:00am - 4:00pm	17(77.27)	0 (0.0)	0 (0.0)	0 (0.0)	5(22.73)
	4:01- 9:00pm	13(56.52)	1(4.35)	1(4.35)	0 (0.0)	8(34.78)
	9:01- 5:59am	12(42.86)	0 (0.0)	0 (0.0)	1(3.57)	15(53.57)
Place of attainment of injury	Central region	34(54.84)	1(11.61)	0 (0.0)	1(1.61)	26(41.94)
	Western region	5(83)	0 (0.0)	0 (0.0)	0 (0.0)	1(17)
	Eastern region	2(100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Northern region	1(33.33)	0 (0.0)	1(33.33)	0 (0.0)	1(33.33)
	Southern region	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Pattern of mandibular fractures

Forty (54.8 %) of the patients had single mandibular fractures with a displacement in 50% of them (Table

3). Comminuted fractures were observed in 2 (5%) of the patients with single mandibular fractures in the body and angle of the mandible (Table 3).

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

Table 3. The frequency distribution of patients with single mandibular fractures according to anatomic site, displaced and comminuted fractures (n=40)

Fracture site	Displaced fractures, n (%)		Comminuted fractures, n (%)	
	Yes	No	Yes	No
Dento-alveolar	4 (20.0)	2 (10.0)	0 (0.0)	6(15.78)
Symphysis	4 (20,0)	2 (20,0)	0 (0.0)	6(15.78)
Parasymphysis	3 (15.0)	6 (30.0)	0 (0.0)	9(23.68)
Body	3 (15.0)	7 (35.0)	1 (50.0)	9(23.68)
Angle	3 (15.0)	3 (15.0)	1(50.0)	5 (13.16)
Ramus	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Condyle	3 (15.0)	0 (0.0)	0 (0.0)	3(7.89)
Coronoid	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	20 (50.0)	20 (50.0)	2(5.0)	38(95.0)

Thirty three (45%) of the patients had multiple mandibular fractures, 27 of them with displacement (Table 4). Six percent (n =2) of the multiple fractures were comminuted in the combination of the symphysis and condyle as well as the parasymphysis and the angle of the mandible. Ninety one percent (n=30)

of the patients with multiple mandibular fractures were bilateral (Table 4). The most common fracture combination (33%, n = 10) was involving the body and angle of the mandible, and were non-comminuted (Table 4).

Table 4. The frequency distribution of patients with multiple mandibular fractures according to anatomic site, displaced or comminuted fractures and bilaterality (n=33)

Fracture combination site	Displaced fractures, n (%)		Comminuted fractures, n (%)		Bilaterality, n (%)	
	Yes	No	Yes	No	Unilateral	Bilateral
S+D/A	1 (3.7)	0 (0.0)	0 (0.0)	1 (3.2)	1 (33.3)	0 (0.0)
S+A	1 (3.7)	1 (16)	0 (0.0)	2 (6.5)	0 (0.0)	2 (6.7)
S+P	1 (3.7)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	1 (3.3)
S+C	2 (7.1)	0 (0.0)	1 (50.0)	1 (3.2)	0 (0.0)	2 (6.7)
S+A+C	1 (3.7)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	1 (3.3)
S+B	1 (3.7)	1 (16)	0 (0.0)	2 (6.5)	0 (0.0)	2 (6.7)
P+A	3 (11)	0 (0.0)	1 (50.0)	2 (6.5)	0 (0.0)	3 (10)
P+B	3 (11)	0 (0.0)	0 (0.0)	3 (10)	0 (0.0)	3 (10)
P+B+C	1 (3.7)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	1 (3.3)
B+A	7 (26)	3 (50)	0 (0.0)	10 (32.0)	0 (0.0)	10 (33.0)
B+B	5 (19)	1 (16)	0 (0.0)	6 (19.3)	1 (33.3)	5 (17.0)
B+R	1 (3.7)	0 (0.0)	0 (0.0)	1 (3.2)	1 (33.3)	0 (0.0)
Total	27 (82.0)	6 (18)	2 (6.0)	31 (94.0)	3 (9.0)	30 (91.0)

S=symphysis, D/A=dento- alveolar, P=parasymphysis, B=body, A=angle, R=ramus, C=condyle.

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

DISCUSSION

The present study comprised of consecutively recruited patients (n=73) aged 3 to 55 years with mandibular fractures attending Oral and Maxillofacial Surgery unit in Mulago Hospital. It was not possible to randomly select the study participants because of low numbers of victims with mandibular fractures attending the health facility, implying that the findings of the study may not be extrapolated to represent the general population.

Generally, the most common causes of mandibular fractures were RTA and assault, which is in agreement with previous studies in United Arab Emirates²⁰ and Pakistan¹⁴. However, RTA was a more frequent cause of mandibular fractures as compared to assault (Table 2) similar to what was earlier observed in Uganda¹⁷ and other developing countries^{15,21,22}.

Apart from RTA and assault, other causes like falls^{11,12}, gunshots²³, were not prevalent in the present study, which supports the notion that the causes of mandibular fractures tend to vary with geographical region, socioeconomic status, culture, religion and time of the day^{11-13,24}.

In the present study, most patients with mandibular fractures were aged 30 years or less, which is consistent with previous studies^{17,24-26}. It could be hypothesized that the second and third decades of life are the most active period leading to higher vulnerability to traumatic injuries. The male to female ratio was about 8:1, which corroborates findings from previous studies in Uganda¹⁷, United States of America², and Lithuania²⁴ and India²⁵. The reason for the observed high male to female ratio is not obvious, but it could be assumed to be due to gender based activities; males being more involved in risky adventures such as riding motorcycles, driving vehicles, fighting and jobs involving climbing.

In the present study, alcohol consumption contributed about 16% of mandibular fractures (Table 2) compared to 79% in Thailand⁸, 29% in Canada⁹ and 21% in Philippines²³. However, in an earlier study¹⁷ in Uganda, all the respondents (n=87) denied any influence of alcohol at the time of attaining the injuries. Similarly, there was no reported influence of alcohol on mandibular fractures in Iran²⁷ probably because alcohol is outlawed in Islamic countries. Among alcohol abusers, 83.3% of patients sustained mandibular fractures following assault (Table 2). This

value is higher than 65% recorded in Johannesburg²⁸ and 37% in Canada⁹.

In the present study, most of the patients who sustained mandibular fractures following RTA were pedestrians, passengers or motorcyclists (Table 2). However, there is no similar previous study to which this finding could be compared. We observed majority (70%) of the fractures were attained in the evening and at night, comparable to 60% reported in Lithuania²⁴. This could be due to poor visibility at night leading to accidents and the use of the cover of darkness by assailants.

Most of the patients came from the central region of Uganda (Table 2) and more so the Kampala Metropolitan area probably because of proximity to the site of study. In the Uganda Police Force Report of 2007-2011, the majority of the accidents occurred in the Kampala Metropolitan area due to the rapid increase in population and road traffic, especially the use of commercial motorcycles (Boda-Bodas).

Overall, in the present study, the body of the mandible was the most commonly fractured site while there was no observed fracture involving the coronoid. This finding was consistent with the observation in Brazil⁷. About a third of the fractures were involving the symphysis and parasymphysis which compares with findings in a Canadian study⁹, but lower than 45.3% of parasymphysial fractures seen in Thailand⁸.

The Condyle fractures were seen in 6.5% of the patients (Table 3), which is much lower than 42% in German²⁹ and 34% in India³⁰. We recorded 6.5% of patients with dental alveolar fractures, which was slightly lower than 7.4% seen in Brazil⁷. About half (55%) of the patients had single fractures (Table 3) compared to 40% recorded in Canada⁹, 52% in Brazil⁷ and 75.5% in Kenya⁶.

CONCLUSION

The present study indicated that road traffic accidents and assaults were major causes of mandibular fractures, particularly among the youths in the study population. Males were more prone to mandibular fractures.

RECOMMENDATIONS

There is a need to reduce the causes of mandibular fractures such as enforcement of rules and regulations regarding traffic and alcohol consumption especially among the male youths.

Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

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Etiology and Pattern of Mandibular Fractures among Patients Attending Oral and Maxillofacial Surgery Unit in Mulago Hospital, Uganda: A Cross-Sectional Study

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