Pattern and Management of Maxillofacial Trauma in Selected Trauma Units Across Africa: A Prospective Pilot Study

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Abbreviations

RC: Road crashes
RTI: Road traffic injuries
SSA: Sub-Saharan Africa
DH: Douala hospital
KBTH: Korle-Bu Teaching Hospital
MH: Maiduguri
SBAH: Steve-Biko Academic Hospital
RSA: Republic of South Africa
UCH: University College Hospital

Abstract

Introduction: Trauma to the facial region could lead to considerable social, psychological and economic consequences. With the African region being a major contributor to global trauma events, we set out to describe the epidemiology and management of maxillofacial trauma in selected trauma units across Africa.

Materials and Methods: This was a six-month prospective multicentre study carried out during March—September 2021.The study involved five major hospitals across the African continent. The patterns of maxillofacial injuries were recorded and patients managed according to local standardized operating protocols. Treatment delays and postoperative complications were recorded at review. Data analysis included descriptive statistics and regression analysis ($p < 0.05$). P Findings.

A total of 195 patients were included in the study. The age range of patients was 1–87 years, with a mean age of 32.4 (SD = ± 16.1). The study population consisted of 43 (22.1%) females, accounting for a Male:Female ratio of 3.5:1. Lacerations were the most common soft tissue injuries observed, while the prevalence of upper-, mid-, and lower- third fractures were 5.1%, 33.8%, and 19.5% respectively. There was loss of consciousness in 27.2%. Road crashes were the predominant aetiology of injuries, while 33.8% had concomitant injuries. About 38.3% of participants experienced treatment delays. Compared to employed patients, unemployed patients had significantly higher odds of experiencing treatment delays (OR = 3.76; 95%CI: 1.62 – 8.73).

Conclusion: With the overwhelming contribution of road crashes, measures to ensure road safety are needed to significantly reduce maxillofacial injuries in the African region, while also reducing socioeconomic inequality to timely treatment.

Introduction

Injuries to the maxillofacial region are gaining prominence as disfigurement and trauma to this area could lead to considerable psychological, social and economic consequences [1]. The maxillofacial area is a vital region related to important structures such as eyes, upper airway and digestive tract, adding to its significance in clinical management and outcomes.

Having diverse aetiologies and risk factors, injuries are broadly classified as intentional and unintentional, with more than 90% of global deaths from injuries in low- and middle-income countries [2]. Africa contributes 16% to global road traffic deaths and has the highest road fatality rate globally, despite the region having 2% of the world's vehicles. Pedestrians, cyclists and people riding motorized two- and three-wheelers constitute more than half (52%) of road users killed on the African roads [3].

Similar to the pattern of injuries in general, maxillofacial injuries are likely to be from road crashes, significantly affecting more males [4]. Studies from several countries of the African continent showed that maxillofacial trauma is more common in the second, third and fourth decade, with the third decade being the most vulnerable age group [5,6,7]. Trends in maxillofacial trauma also suggest that it varies in different geographical areas. Preventive strategies are vital in mitigating the high prevalence of maxillofacial injuries. For such actions to be practical, it is crucial to assess the epidemiology of maxillofacial trauma to manage and advocate for appropriate measures for prevention, as the burden of injuries is said to be decreasing in high-income countries, while it is increasing in sub-Saharan Africa (SSA) [3].

There is sparse contemporary data regarding the epidemiology of maxillofacial trauma across Africa, with several authors emphasizing the need for attention to be drawn to maxillofacial injuries as a major pertinent health problem [8]. This study therefore gives a current perspective of maxillofacial injuries across several units in Africa to inform trauma program evaluations.

Materials and Methods

Study Design and Study Population

This was a prospective multicentre study on the epidemiology and management of maxillofacial trauma in Africa from 15 March 2021 to 15 September 2021. Centres involved in the study were the Douala Hospital (DH), Cameroon, Korle-Bu Teaching Hospital (KBTH), Ghana, Maiduguri Hospital (MH), Nigeria, Steve-Biko Academic Hospital (SBAH), South Africa, and the University College Hospital (UCH), Ibadan, Nigeria. Study protocols were standardised across all centres. The study population was made up of patients who presented to the various centres on account of maxillofacial injuries. Inclusion criteria were patients with maxillofacial injuries who consented, or had a guardian to consent to participate in the study. Exclusion criteria were unidentified unconscious patients, and patients managed in other facilities who presented with treatment failure.

Data Collection Procedure

Patients with maxillofacial injuries, presented to the Emergency Department or the Oral and Maxillofacial clinic of the various centres. These patients were given standard care and managed per the centres' treatment guidelines. All patients meeting the inclusion criteria were then consecutively selected at presentation. They were assigned to a senior registrar for follow up. Informed consent was obtained at discharge and only then were patients included in the study. Patients and/or guardians were interviewed after, and additional information regarding injuries obtained from their records. Data was collected with a verified paper-based questionnaire. The questionnaire was converted into an electronic format by loading onto Qualtrics. A common link with the same questionnaire was provided to all participating units.

Ethical approvals were sought from the Korle Bu Teaching Hospital Institutional Review Board (KBTH-IRB 0004/2021), National Health Research Ethics Committee of Nigeria (NHREC/01/01/2007–14/03/2021), University of Ibadan/ University College Hospital, Research Ethics Committee (NHREC/05/01/2008a), Faculty of Health Sciences Research Ethics Committee, (FHSREC) University of Pretoria (Ethics Reference number 5/2021), and the Ministry of Public Health's Institutional Ethics Committee of the Republic of Cameroon (N*2020/0063/HGOPED/DG/CEI).

Measures

Data obtained for this study included sociodemographic characteristics (age, sex, employment status), aetiology of injury, time taken to present to the facility, and treatment delays. Management delays were classified as follows: 'No delay'-less than 24 h; 'Acceptable delay'- 2–7 days; 'Long delay'- 8-21 days; and 'supervised neglect'-more than 21 days. Records of all examination findings were also taken, including maxillofacial findings as well as concomitant injuries. Investigative tools, treatment modality and length of hospital stay (days from presentation to discharge) were noted. Post-operation complications were recorded at the review visit.

Data Analysis

The data collected across centres were merged, and imported to IBM SPSS version 28.0 for analysis. The frequency description of injury pattern computed included age distribution, aetiology, and site of the injuries. These were further compared among the different participating study sites. Treatment modalities and delays for maxillofacial injuries were reported. Group differences were tested using chi-square statistics and, fisher's exact test where expected cell counts were less than 5. Binary logistic regression model was used to explore sociodemographic factors associated with any treatment delays, irrespective of the length of the delay (all coded 1) as compared to not reporting treatment delays (coded 0). The regression model control for level of consciousness as potential confounder. Statistical significance for all tests was set at $p < 0.05$.

Results

Five maxillofacial units from four countries participated in the study. These included Cameroon (one unit), Ghana (one unit), Nigeria (two units) and South Africa (one unit). A total of 195 patients that reported to these units over the study period with maxillofacial trauma were included in the study. None of the included patients got lost to follow up. The age range of patients was 1—87 years, with a mean age of 32.4 (SD = 16.1). The study population consisted of 43 (22.1%) females, accounting for a M:F ratio of 3.5:1. Among the participants, 112 (58.9%) were employed and 79 (41.1%) of the patients were unemployed. One hundred and seventeen patients (60%) presented within 24 h after injury while 78 (40%) presented later. Among patients who were involved in car crashes as passengers/drivers, 88.6% reported not being in seatbelts, while only 22% of patients had definitive treatment being initiated after 24 h (Table 1). With the exception of South Africa which had interpersonal violence being the primary cause of injuries, all other centres had road crashes being the predominant aetiology of maxillofacial trauma. Compared to employed patients, unemployed patients had a significantly higher odds of experiencing treatment delays (OR = 3.76; 95%CI: 1.62 – 8.73).

Table 1. Characteristics associated with maxillofacial injuries among study participants

Variable	Number	(%)
Type of accident/injury cause		
Cause of injury		
Road Crashes (RC)	123	63.1
Interpersonal violence	48	24.6
Falls	14	7.2
Others (Industrial, bumped door, animal assault, epilepsy, gunshot, insurgency)	10	5.1
RC transport type ($n=123$)		
Motor Vehicle	68	55.3
Motor bike/ Bicycle	55	44.7
Role in RC ($n=123$)		
Driver	8	6.5
Passenger	28	22.8
Pedestrian	36	29.3
Not applicable	51	41.5
*Loss of consciousness		
Yes	53	27.2
No	139	71.6
Delay in treatment		
****Management delay***		
No (>24Hours)	71	61.7
Acceptable delay (2-7 days)	22	19.1
Long delay (7-21 days)	14	12.2
Supervised neglect (>21 days)	8	7
*Reason for delay		
Facility Resource constraint (Hospital work load / theatre availability / industrial action)	12	34.3
Patient non-compliance	12	34.3
Financial reasons	2	5.7
	9	25.7
Risk factors		
Protection Used (n=123)		
Yes	12	9.8
No	111	90.2
Alcohol use		
No	174	89.2
Yes	21	10.8

*Not recorded for all participants

There was no statistically significant differences in treatment delays by sex ($p = 0.282$), alcohol use ($p = 0.265$), vehicle type ($p = 0.400$), and loss of consciousness ($p = 0.408$).

Lacerations were the most common soft tissue injuries observed (Table 2). These lacerations were however predominantly longer than 10 cm in length. The prevalence of upper-, mid-, and lower- third fractures were 5.1%, 33.8%, and 19.5% respectively. Thirteen patients (6.7%) also sustained fractures of the temporomandibular joint. In all centres, the fractures of the midface were the most prevalent (Table 2). There was evident nerve involvement in 19 (9.7%), and various eye signs and symptoms in 29.7% of the study participants. Loss of consciousness was present among 22% of Cameroonian, 23.8% South African, 28.8% Ghanaian and 30.4% Nigerian participants.

Table 2. Regional distribution of maxillofacial injuries

Nature of injury	Units					Total
	Cameroon, DH (*n*=19)	Ghana, KBTH (n=60)	Nigeria, UCH (n=48)	Nigeria, MH (n=21)	South Africa, SBAH (n=43)	(n=195)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Soft Tissue						
Abrasion	42.1 (8)	31.7 (19	35.4 (17)	38.1 (8)	30.2 (13)	33.3 (65)
Contusion	42.1 (8)	3.3 (2)	8.3 (4)	38.1 (8)	25.6 (11)	16.9 (33)
Laceration > 10 cm	31.6 (6)	63.3 (38)	66.7 (32)	47.6 (10)	32.6 (14)	51.3 (100)
Laceration < 10 cm	0	1.7 (1)	0	14.3 (3)	18.6 (8)	6.2 (12)
Avulsion requiring reconstruction	10.5 (2)	8.3 (5)	12.5 (6)	19 (4)	0	8.7 (17)
Crushing injury	0	0	2.1 (1)	9.5 (2)	2.3 (1)	2 (4)
Hematoma	0	1.7 (1)	0	0	4.7 (2)	1.6 (3)
Eyelid laceration	5.3 (1)	0	0	0	4.7 (2)	1.6 (3)
Lip laceration	0	1.7 (1)	2.1 (1)	0	11.6 (5)	3.6 (7)
Other (chin, degloving injury)	52.6 (10)	1.7 (1)	2.1 (1)	9.5 (2)	11.6 (5)	9.7 (19)
Hard Tissue						
Upper third fracture	10.5 (2)	5 (3)	2.1 (1)	14.3 (3)	0	5.1 (10)
Midface fracture	26.3 (5)	33.3 (20)	39.6 (19)	38.1 (8)	30.2 (13)	33.8 (66)
Mandible fracture	10.5 (2)	16.7 (10)	33.3 (16)	28.6 (6)	9.3 (4)	19.5 (38)
TMJ fracture	0	0	12.5 (6)	14.3 (3)	9.3 (4)	6.7 (13)

CT scans were the most utilized imaging modality across all centres of this study, being used in 36% of the study population. Plain radiographs were also fairly employed as Dental panoramic radiographs and postero-anterior view of skull/mandible were utilized in 18.5% and 16.4% respectively. Occipito-mental views, CBCT, oblique lateral views of the mandible and reverse Towne's views were also used to investigate maxillofacial fractures. Modalities for treating maxillofacial trauma is shown in Table 3. Fifty-two percent (52%) of participants had procedures done under general anaesthesia; while 45.9% had procedures done under local anaesthesia. In 2.4% of participants, conscious sedation was employed.

Table 3. Treatment modalities for maxillofacial fractures

Units	None % (n)	Open reduction % (n)	Closed reduction % (n)	Conservative % (n)
Cameroon, DH ($n=19$)	57.9 (11)	0	5.3 (1)	10.5 (2)
Ghana, KBTH ($n=60$)	35 (21)	6.7 (4)	11.7 (7)	15 (9)
Nigeria, UCH ($n=48$)	27.1 (13)	29.2 (14)	8.3 (4)	6.3 (3)
Nigeria, MH ($n=21$)	0	57.1 (12)	23.8 (5)	0
RSA, SBAH ($n=43$)	0	16.3 (7)	32.6 (14)	14 (6)
Total reported ($n=$)	45	38	31	20

Sixty-six study participants sustained various concomitant injuries. Most of these (13.3%) involved the central nervous system, while 11.8% involved other bony fractures. Among patients with concomitant injuries, 19.7% involved multiple sites. Table 4 shows the distribution of concomitant injuries among various sociodemographic characteristics. There was evidence of surgical site infection among 2.1% of participants with surgical interventions. The mortality

Table 4. Distribution of concomitant injuries

Variables	Presence of concomitant injuries % (n)		*P*-value
	No	Yes	
Gender			0.767
Male	74.3 (113)	25.7 (39)	
Female	72.1 (31)	27.9 (12)	
Employment status			0.008
Unemployed	83.3 (65)	16.7 (13)	
Employed	66.1 (74)	33.9 (38)	
Alcohol use			0.066*
No	71.8 (125)	28.2 (49)	
Yes	90.5 (19)	9.5 (2)	

*Fisher's exact Test

Discussion

This study among other things, gives a current perspective of the modalities of maxillofacial injury management in Africa. Although assault and falls played some role in the occurrence of maxillofacial injuries, road crashes were the predominant cause across all centres involved in this study. This observation has been consistent over the past couple of decades in several indigenous studies [9,10,11,12]. In South Africa however, assault and interpersonal violence was predominant, which corroborated other studies in the region [13, 14].

Road safety policies and regulations across the African continent need to be prioritized as many lives are lost on account of RC. Rolison et al. indicated the important contributions of over speeding, influence of drugs/alcohol, use of mobile phones, and distractions during driving to the occurrence of road crashes [15]. Incidentally, Africa has the most proportion of cyclist and pedestrian mortalities in road deaths [16]. Although speed, substance and mobile phone use while driving seem to be established modifiable risk factors, an important element which should additionally be strictly enforced by regulatory agencies is the use of seat belts and protective gear. Even more than airbags, seat belts are known to significantly reduce mortality from road crashes [17]. The unfortunate state of maxillofacial trauma in this study was that majority of victims of road crashes did not use protection available for their vehicles or motorcycles. This finding concurs with the world multicentre study in which more than 76% of vehicle user did not wear protection designed for their vehicles [18]. Most maxillofacial trauma patients in this study were males. This was the pattern in all these maxillofacial units, agreeing with several studies globally [19,20,21]. Also, the dominant age groups among participants were those in the second and third decades of life, a period of active work life and social life. Hence these groups were more likely to be involved in movements compared to other age groups. Nonetheless, it is pertinent to note that those who were currently working were less likely to have reported experiencing treatment delays compared to the unemployed patients who are perhaps more likely to have been financially constrained in accessing some treatment modalities. This observation of socioeconomic inequality in timely treatment calls for support for universal health coverage that removes any form of financial barrier to healthcare across the region.

About a quarter of our study population presented with loss of consciousness, suggesting the proportion of high impact trauma with maxillofacial involvement. This might have influenced the high proportions of mid-third fractures. Contrary to international trends which suggest the mandible to be the most affected facial bone in trauma, [22, 23] and even other studies within the African continent [11, 24, 25]. While the anatomical distribution of fractures may be related to the prevalent injury mechanism, it could also be influenced by the specific study site. Furthermore, tertiary centres are more likely to receive more advanced and complicated cases.

Anatomical proximity of the cranium to the maxillofacial region makes it prone to associated injuries when the maxillofacial region is affected by trauma [26]. This study revealed that closed head injuries, followed by orthopaedic injuries were the most common concomitant injuries. This finding is inconsistent with studies by Adebayo et al [24] and Parkins et al [11], who reported orthopaedic injuries to be the most concomitant injuries associated with maxillofacial trauma.

All the units involved in the study have access to both two dimensional (2D) and three dimensional (3D) radiographic imaging, which makes them suitable for diagnosing maxillofacial trauma. Although most units reported on soft tissue injuries associated with maxillofacial fractures, others reported on isolated soft tissue injuries as well. Regarding soft tissue management, most of these were treated with debridement and primary closure on outpatient basis. Majority of the patients from four units were treated with both open reductions and internal fixation (ORIF) and closed reduction of fractures which concurs with another multicentre study [18].

Our study is limited by the small number of participants, as well as the limited period of recruitment. The timeframe of the data collection particularly reflects the period of the peak of the Covid-19 pandemic. Furthermore, some of the null findings might be related to the fact that

this pilot study might have been underpowered to detect statistical significance as it is common with pilot studies. While this might affect the generalization of findings, it brings to light important descriptions regarding maxillofacial trauma and socioeconomic disparities in timely treatment thereof, which could inform several social and academic programs.

Conclusion

There is a varying distribution of injuries across the selected study centres within the African continent. With the overwhelming contribution of road crashes, measures to ensure road safety are needed to significantly reduce maxillofacial injuries in the African region, while also introducing interventions to reduce socioeconomic inequality to timely treatment.

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Ethics declarations

Conflict of interest

The authors declare that there is no conflict of interest.

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