

## Epidemiological Analysis of Oral and Maxillofacial Fracture in the Teaching Hospital of Kinshasa University: Preliminary Study (Part A)

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### ABSTRACT

**Background:** Epidemiology survey of maxillofacial fractures changes with variation in the geographical region, socioeconomic strategy, cultural and environmental factors.

**Aims:** To investigate the etiology and analyze the pattern of Oral and Maxillofacial fracture in order to understand the problem in this geographic region and improve its management.

**Materials and Methods:** A cross-sectional study of 7- year was conducted among 287 patients with maxillofacial fractures who reported to the Department of Dental Medicine, Stomatology and Maxillofacial Surgery Service in the Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of Congo. A pre-investigation form was prepared to collect data including age and gender distribution, etiology, type of fracture, treatment delivered and its outcome. The t- student test was performed to compare the variables among gender. Chi-square test was performed to assess the association between different variables. The significance level was set at 0.05.

**Results:** Out of 287 patients, 67.6% were male and 32.4% female with sex ratio of 2.08:1. The age group between 20-29 years was most affected (36.93%) by maxillofacial fractures. Mandible fractures were most prevalent (60.2%) followed by zygomatic (17.1%). Road traffic accidents accounted for 43.29%, followed by assault (39.69%). Significant association between the gender and cause of trauma was

found (P=0.002). 45.99% of patients were treated by ligation of Erich's Arch bars associated to intermaxillary fixation, followed by observation only (36.23%).

**Conclusions:** The Road traffic accidents are the major cause of maxillofacial fracture with male preponderance followed by assault with female preponderance.

**Keys words:** Maxillofacial Fracture, Road Traffic Accidents, Assault Accidents.

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### INTRODUCTION

Epidemiological survey changes with variation in the geographical region, socioeconomic strategy, cultural and environmental factors. A trauma of the maxillofacial region is one of the most important health hazards across the world arising from physical injuries, due to various reasons. This leads to severe morbidity, cosmetic disfigurement as well as difficulties in oral functioning. Depending on the prevalence of physical traumas and their deleterious effects on individuals, these injuries are among the major health concerns worldwide.<sup>1</sup>

Many published studies<sup>2-4</sup> focusing on incidence and causes of maxillofacial injuries have reported varying epidemiological figures that differ over the decades in the mechanism, severity and causes of injuries from one country to another and even within the same country.<sup>5-10</sup> Earlier studies from Nigeria<sup>2</sup>, Libya<sup>3</sup>, Pakistan<sup>4</sup>, and Sharjah in United Arab Emirates<sup>2</sup> showed that road traffic accidents (RTA) were the most common cause of maxillofacial bone fractures in developing countries, while the developed countries most frequent mode is assault.<sup>11,12</sup>

Despite several figures of epidemiology of Oral and Maxillo-facial fractures in different countries;<sup>5-10</sup> there is no data regarding the pattern of trauma and its treatment methods in D.R. Congo, particularly in the Teaching Hospitals of Kinshasa University for the last 35 years. The aim in this paper was to investigate the etiology and analyze the pattern of Oral and Maxillofacial fractures for a period of 7 years in order to compare our results with similar recent studies reported in literature and to know the difference in the distribution of the fracture so as to help the surgeons to understand the problem in this geographic region and improve its management. The findings of this study are intended to stimulate further research on this issue and the development of public policies aimed at caring for the population. The Middle face and others fractures of the upper face will be discussed in the second part of this paper.

**MATERIALS AND METHODS**

A cross-sectional study of 7 years was conducted in the Department of Dental Medicine, Service of Stomatology and Maxillofacial Surgery, Teaching Hospital of Kinshasa University, D.R. Congo, Kinshasa from 2007 to 2014. The sample size was calculated at 305 subjects. The exclusion criteria were: the outpatients who didn't require hospitalization, patients with only dentoalveolar fractures, patients who did not complete or gave incomplete information (vehicle involved such as two wheeler, four wheeler or three wheeler bicycle, passengers or driver, marital status, Race, retired, income, education, deleterious habits, use of medication for health problem and left or right site of the maxillofacial fracture); patients undergoing other procedures (opening of the arch bar or removal of a plate) in patients who underwent maxillofacial surgeries before; and patients with soft tissue injuries only.

Patients who died before initial assessment in the Hospital and those who were not recalled according to treatment plan were also excluded from the study. After excluding these cases, 287 patients participated in the study.

A pre-investigation form was prepared for this study in order to collect data. All demographic data such as patient's age and gender were collected, screening, and the patients' medical records were reviewed to extract information related to the variables needed such as the cause of trauma, an involved injured bones, fractures and the mode of injury, localization of maxilla-facial fracture sites, the exact mandibular status, and treatment modalities with its outcome. The mode of injury was classified as road traffic accident (RTA), assault, fall from height, occupational, sports, gunshot, pathological and others (animal attack, explosive injury.). Fractures were assessed according to location exclusively mandible and Maxilla. Sites of mandibular fractures were classified as symphysis, parasymphysis, body, angle, ramus, condyle, coronoid and dento-alveolar. The fractures were treated using the following methods in the department: osteosynthesis, Immobilization with Ligation of the Erich's Arch bars with internal maxillary fixation by wires and elastics, Immobilization with Ligation of Erich's arch bars without internal maxillary fixation and Observation only. All maxillofacial fractures were diagnosed by conventional, panoramic radiographs and also by the computed tomography and magnetic resonance imaging.

Descriptive statistics with mean and standard deviation was used. The t-student test was performed to compare the variables between genders. Chi-square test was performed to assess the association between qualitative and quantitative variables. The significance level was set at 0.05, the Package for the Social Sciences—SPSS version 21 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis.

**Table1: Distribution of patients according to the age group and sex**

| Age group (years) | Frequency        |                 | Total no. of patients (n= 287) | Percentage (%) |
|-------------------|------------------|-----------------|--------------------------------|----------------|
|                   | Male (n=194)     | Female (n=93)   |                                |                |
| 0-9               | 5(2.58%)         | 4 (4.30%)       | 9                              | 3.14           |
| 10-19             | 30(15.46%)       | 16 (17.21%)     | 46                             | 16.03          |
| 20-29             | 70(36.08%)       | 36(38.71%)      | 106                            | 36.93          |
| 30-39             | 48(24.74%)       | 15(16.13%)      | 63                             | 21.95          |
| 40-49             | 22(11.34%)       | 5(5.38%)        | 27                             | 9.41           |
| 50-59             | 12(6.19%)        | 9(9.68%)        | 21                             | 7.32           |
| 60 and plus       | 7(3.61%)         | 8(8.60%)        | 15                             | 5.23           |
| <b>Total</b>      | <b>194(100%)</b> | <b>93(100%)</b> | <b>287</b>                     | <b>100</b>     |

**Table 2: Frequency Distribution of patients according to anatomical fracture site**

| Anatomic location | Frequency (n=349) | Percentage |
|-------------------|-------------------|------------|
| Nasal             | 25                | 8.7        |
| Zygomatic arch    | 19                | 6.6        |
| Mandible          | 173               | 60.2       |
| Maxilla           | 39                | 13.5       |
| Orbit             | 17                | 5.9        |
| Zygomatic         | 49                | 17.1       |
| Nasoorbitoethmoid | 16                | 5.6        |
| Palatal plits     | 9                 | 3.1        |
| Others            | 2                 | 0.7        |
| <b>Total</b>      | <b>349</b>        | <b>100</b> |

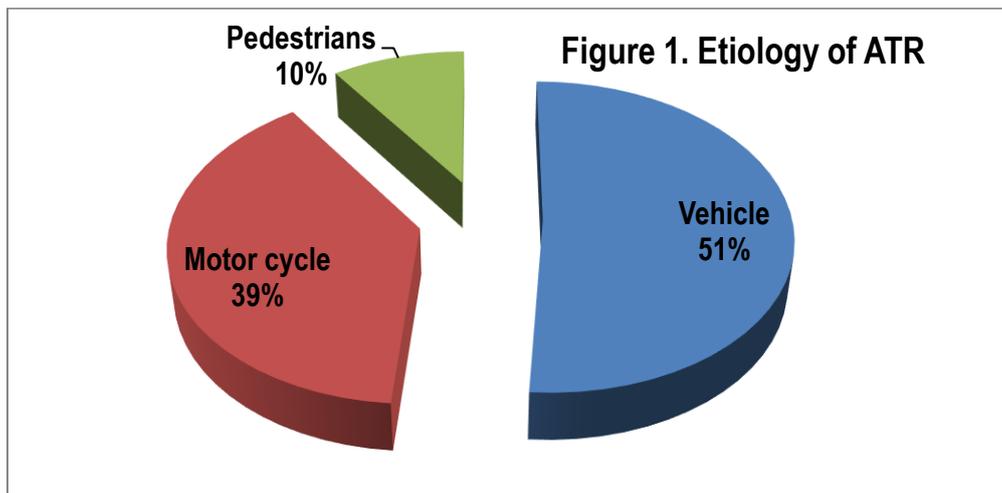


Table 3: Frequency of anatomical location of mandibular fractures.

| Fractures site | Frequency | Percentage |
|----------------|-----------|------------|
| Symphysis      | 7         | 4          |
| Parasymphysis  | 52        | 30.1       |
| Body           | 15        | 8.7        |
| Angle          | 32        | 18.5       |
| Ramus          | 5         | 2.9        |
| Condyle        | 27        | 15.6       |
| Coronoid       | 0         | 0          |
| Dentoalveolar  | 35        | 20.2       |
| Total          | 173       | 100        |

Table 4: Distribution etiology of fracture according to the gender and number of patients

| Etiology              | Male (n=194) | Female(n=93) | No. of Patients (n=287) |
|-----------------------|--------------|--------------|-------------------------|
| RTA                   | 84 (43.29%)  | 38 (40.86%)  | 122 (42.50%)            |
| Assault               | 77 (39.69%)  | 41(44.08%)   | 118 (41.11%)            |
| Sports                | 6 (3, 09%)   | 0            | 6(2.09%)                |
| Gunshot               | 2 (1.03%)    | 0            | 2(0.69%)                |
| Fall                  | 2(1.03%)     | 0            | 2(0.69%)                |
| Occupational          | 19 (9.79%)   | 13(13.97%)   | 32(11.14%)              |
| Pathologic/iatrogenic | 2 (1.03%)    | 1(1.07%)     | 3(1.05%)                |
| Others                | 2(1.03%)     | 0            | 1(0.69%)                |
| Total (%)             | 100          | 100          | 100                     |

**RESULTS**

Out of 287 patients of Oral and Maxillofacial fracture, the age ranged from 2 to 80 years with a mean age of 30.9 years (SD±9.43). The age group between 20-29 years had a highest incidence of 106 patients. The male predominance was seen (67.6%) than females (32.4%) with a sex ratio of 2.08:1 (Table1). According to anatomical location, mandible fractures were most prevalent (60.2%) followed by zygomatic fractures (17.1%) and maxilla fracture (13.5%) as presented in Table 2.

The most common fracture sites for the mandible were parasymphysis (30.1%), followed by dento-alveolar (20.2%) and angle of mandible with condyle (18.5% and 15.6%) as show in Table 3. Table 4 reveals that the most common mode of injury in male was RTA (43.29%) followed by assault (39.69%), Occupational (9.79%), Sports (3.09%). In females the assault was most common mode of injury (44.08%) followed by RTA (40.86%).

The most common etiology of RTA was vehicle, followed by motor cycle and Pedestrians' vehicle (Figure 1)

The Chi-square test showed a significant association between the gender and cause of trauma (2-tailed; P=0.002), with an exception of occupational and pathologic etiologies (P=0.04 and 0.03). Males were more prone to ATR, Assault, Sport, Gunshot, fall and others, as compared to females (Tables 4, 5). Out of 287 patients (100 %), 45.99% were treated by ligation of Erich's Arch bars + intermaxillary fixation (IMF), followed by observation only (36.23%) and ligation of Erich's Arch bars without IMF. Those treated by osteosynthesis and plaster were (2.78%) and (2.09%) respectively. No patient was treated by autografts, synthetic grafts and soft tissue transfer (Table 6).

A total of 55 complications (19%) were recorded with 23% having surgical site infection followed by mal occlusion and hypertrophic scars (19% and 10%).

**Table 5: Association between the cause of maxillofacial fractures and gender.**

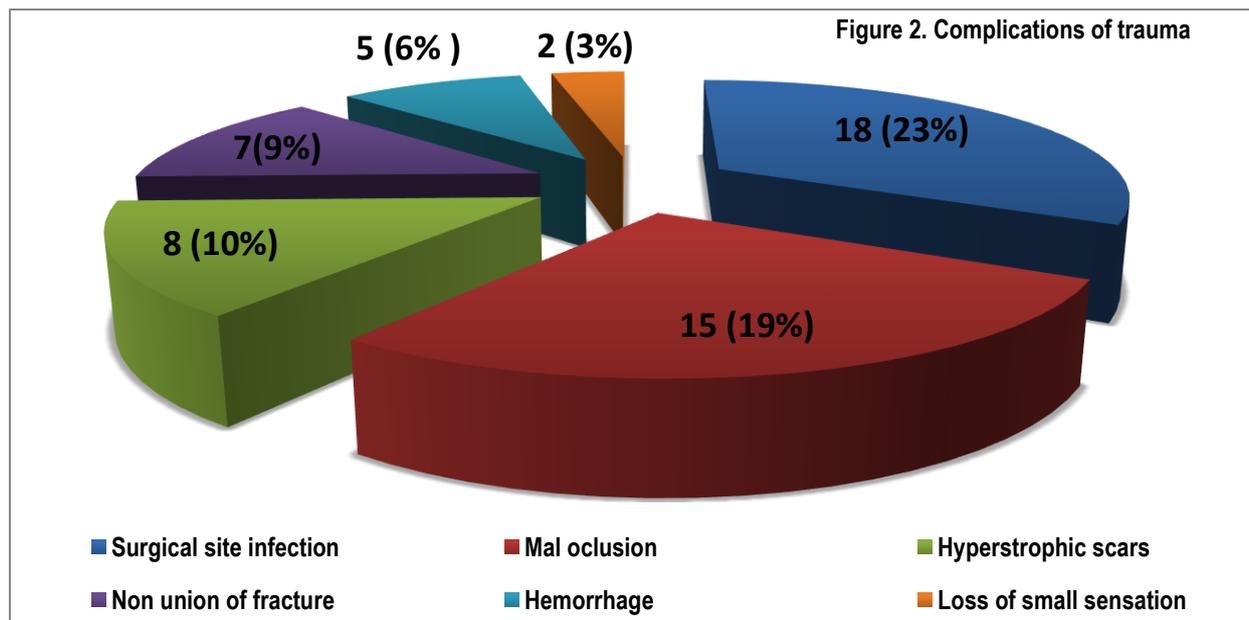
| Variables | Etiology of Oral and Maxillofacial Fracture |                    |                  |                    |                 |                  |                   |                   |                  | Exact sig. (2-tailed) <sup>a</sup> |
|-----------|---|--------------------|------------------|--------------------|-----------------|------------------|-------------------|-------------------|------------------|------------------------------------|
|           | ATR Number (%)                              | Assault Number (%) | Sport Number (%) | Gunshot Number (%) | Fall Number (%) | Occup Number (%) | Pathol Number (%) | Others Number (%) | Total Number (%) |                                    |
| Male      | 84 (68.9%)                                  | 77 (65.3%)         | 6 (100%)         | 2 (100%)           | 2 (100%)        | 19 (59.4%)       | 2 (66.7%)         | 2 (100%)          | 194 (67.6%)      | 0.002                              |
| Female    | 38 (31.1%)                                  | 41 (34.7%)         | 0 (0%)           | 0 (0%)             | 0 (0%)          | 13 (40.6%)       | 1 (33.3%)         | 0 (0%)            | 93 (32.4%)       |                                    |
| Total     | 122 (100%)                                  | 118 (41.11%)       | 6 (100%)         | 2 (100%)           | 2 (100%)        | 32 (100%)        | 3 (100%)          | 2 (100%)          | 287 (100%)       |                                    |

Pathol=pathologic; Occup=occupational

**Table 6: Occurrence of treatment methods of trauma according to the number of patients**

| Treatment methods  | NO. Patient (%) |
|--|-----------------|
| Plaster  | 6 (2.09)        |
| Osteosynthesis   | 8 (2.78)        |
| Immobilization with Ligation of the Erich's Arch bars +IMF with wires and elastics | 132 (45.99)     |
| Immobilization with Ligation of Erich's arch bars without IMF                      | 37 (12.89)      |
| Observation only   | 104 (36.23)     |
| Autografts   | 0               |
| Synthetic grafts   | 0               |
| Soft tissue transfer   | 0               |
| Total  | 287             |

IMF: intermaxillary fixation



**DISCUSSION**

Kinshasa is the capital, most developed and largest city in the Democratic Republic of the Congo (DRC), an urban area with a population of over 11 million. The Oral, Stomatology and Maxillofacial Surgery service of the Teaching Hospital of Kinshasa University is the most equipped and developed in the DRC. The analysis of the sample population may provide knowledge about the current distribution of Oral and Maxillofacial fracture as well as help to build a database that may improve medical and dental programs to prevent facial trauma. Therefore, it is of high

significance to identify the etiology and epidemiology of Oral and Maxillofacial fractures.

From the present study, the incidence of male fracture was more prevalent than female with sex ratio of 2.08:1. This finding represents a lower figure as compared to the studies from Uganda (7.7:1)<sup>13</sup>, Switzerland (6.2:1)<sup>14</sup>, Nairobi (8.4:1)<sup>15</sup>, United Arab Emirates (11:1)<sup>2</sup>, Nigeria (16.9:1)<sup>16</sup> and Korea (3.2:1)<sup>12</sup>. However, the sex ratio in the present study correlates positively with the study of Kiran S as well as the study of Innsbruck (2.1:1)<sup>17</sup>, but was high compared to the study of Finland (1.6:1)<sup>18</sup>. The higher

percentage of males in Kinshasa City may be related to the fact that, most males of the families extensively work outdoors resulting to exposure to external unprotected environment and making them more susceptible to involvement in RTA and assault, while females are mostly homemakers or are employed in protected indoor environment like teaching, information technology and other professions. The aggressive behavior of boys compared to girls can also expose them to the various accidents.<sup>19,20</sup>

Most affected age group was 20–29 years in the present study similar to others studies.<sup>21,22</sup> This could be because people in this age group usually complete their education and venture out in search of jobs and are involved in more outdoor activity making them more vulnerable to injuries as compared to other age groups. However, in the study of Behçet<sup>23</sup>, the most affected age group was 0 to 10 years (27%), followed by 21-30 years (25.8 %). The maximum number of fractures was reported in the mandible. There was a significant association between the cause of fractures and gender. Males were more affected by RTA, Assaults, Sport, Gunshot, fall and other (except occupational and pathologic) causes compared to females. The fracture of maxillofacial regions has several causes or etiological factors, but the Road traffic accident and assaults are the major cause of maxillofacial injury in the teaching Hospital of Kinshasa University. Our results correlate with the findings of several other studies for only RTA.<sup>24,25,10</sup> The increasing number of RTAs in Kinshasa city may be attributed to many factors besides the lack of individual sensitization about the safety devices of the vehicle, lack of adherence to safety rules and regulation, lack of clear road traffic signs, congestion on the road due to lack of separate pathways for pedestrians and motor bicycle, and the large number of old and poorly maintained vehicles, defective roads and poor street lighting. However, cultural differences, sports activities, daily activities, and occupational status might affect the etiology and lead to discrepancies between different studies.

Assault was not a prevalent finding for maxillofacial fracture in some reports.<sup>26,27</sup> Contrary to the present study, Assault was the second main etiological factor for the maxillofacial fracture. This may be attributed to increasing interpersonal violence in the recent times probably due to alcohol. In addition, the rapid modernization, unemployment due to mechanization and population explosion can also be a contribution. Despite the fact that maxillofacial trauma has many origins,<sup>28</sup> and many authors' evocated a high frequency of RTA and Assaults,<sup>29,30</sup> RTA is still the major etiological factor for the maxillofacial fracture, similar to the recent paper.

A motor cycle accident has a lower incidence (39%) than car accidents, but often leads to more serious or even fatal traumas. Assaults occupy the second frequency of trauma; but it has highest percentages of maxillofacial fractures in female (44.08%). These present findings corroborate to those found in Iran,<sup>31</sup> Togo.<sup>32</sup> However, others authors have shown that aggression has more predominance with 41.58% and a relationship between aggression and unemployment was found<sup>33</sup>. In addition, the increase in urban violence observed in this study may be strongly associated with social/economic conflicts to which many people, especially youngsters, are subjected. But, the study of Sandeep et al; Kiran S et al.; Ellis et al and Roccia et al<sup>26,27</sup> found high percentages of Oral and Maxillofacial fractures in female caused

by fall from height (43.48%). Insignificant representation of sports injuries in our paper may be due to the fact that smaller proportion of population are involved in sports which are likely to cause major trauma, and minor sports injuries are more likely to cause dental injuries which are generally managed at outpatient dental clinics and smaller hospitals than the teaching Hospital of Kinshasa University. According to distribution of maxillofacial fractures in present study, the most common involved location was the mandible. Although being the heaviest and strongest facial bone, the mandible is more susceptible to fractures because it is the only movable facial bone and it has anatomical peculiarity in form and location. Various studies have also shown the mandible to be the most affected bone.<sup>34-36</sup> Other studies accounted zygoma to be the maximally involved bone<sup>37,38</sup>, similar with the present paper. One study from Korea found a predominance involving zygomatic fracture (33.9 %), followed by mandible (27.2 %) and dental alveolar fracture (26.6 %).<sup>39</sup>

On the common fracture sites for the mandible bone, condylar fracture was the most common site.<sup>2,10,17,18</sup> However others studies reported body of the mandible as the most common site,<sup>40,41</sup> followed by parasymphysis,<sup>42</sup> symphysis<sup>9</sup> and finally by the angle of the mandible.<sup>6</sup> These results were very different to the present study which found that, the most common fracture site for the mandible bone was para-symphysis with 30.1%, followed by dento-alveolar (20.2%) and angle of mandible with condyle (18.5%). Depending on the results of these several reports and the present finding, it is therefore thus justifiable that epidemiological trauma and causes of maxillofacial injuries tend to vary with geographic location, socioeconomic status, culture, religion of the region, and era.<sup>43</sup> Minor differences in the frequency of fractures can also caused by variations in the etiology of fractures in various studies.

The choice of treatment methods varies from surgeon to surgeon and may differ regionally due to socioeconomic status, health insurance awareness, hospital infrastructure, consultant's skill and patient's willingness governed by religious beliefs. In planning how to manage these patients, the evaluation of treatment effectiveness and understanding the complications may provide a more realistic and consistent interpretation. So it should therefore be noted that, the Oral and Maxillofacial fracture should not only be seen exclusively as a medical condition, but also as a social and economic problem.

All the results should nonetheless be interpreted taking into account some of the limits. The first is obtaining the complete data as it was a retrospective analysis. The second is the obtaining valuable information regarding the literacy status of the patients as an influencing factor and use of protective devices by motor vehicle drivers at the time of injury (these were however available). However, these limits do not totally affect the result presented with the main idea of epidemiology pattern of maxillofacial fracture and etiology factors with the mode of injury.

## CONCLUSION

The Road traffic accidents perceived as the first major cause of Oral and maxillofacial fracture in the Teaching Hospital of Kinshasa University with high incidence in male and Assaults as a second major cause with preponderance to female.

Considering the geographic and cultural indices of the evaluated population, the patients gender and fracture etiology significantly

affect the prevalence of maxillofacial fracture as well as the best treatment plans. An action by the authorities related to public awareness sector by regulation of the rules will be appreciated. Prospective studies with large sample size including all developed major towns and big Centers/ regions of D.R.C with perfect or complete information about the status of the inpatients and the all the influencing etiology factors of trauma are recommended.

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