Maxillofacial injuries among trauma patients undergoing head computerized tomography; A Ugandan experience

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ABSTRACT

Aim: The aim of this study was to investigate epidemiological features of maxillofacial fractures within trauma patients who had head and neck computed tomography (CT) scan at the Mulago National referral hospital.

Methods: CT scan records of trauma patients who had head scans at the Department of Radiology over 1-year period were accessed. Data collected included sociodemographic factors, type and etiology of injury, and concomitant maxillofacial injuries.

Results: A total of 1330 trauma patients underwent head and neck CT scan in the 1-year study period. Out of these, 130 were excluded due to incomplete or unclear records and no evidence of injury. Of the remaining 1200, 32% (387) had maxillofacial fractures. The median age of the patients with maxillofacial fractures was 28 (range = 18–80) years and 18–27 age group was most common at 47.5%. Road traffic accidents constituted 49.1% of fractures. The single most affected isolated bone was the frontal bone (23%). The number of maxillofacial bones fractured was predicted by age group (df = 3 F = 5.358, P = 0.001), association with other fractures (df = 1 F = 5.317, P = 0.03).

Conclusions: Good matched case–control prospective studies are needed to enable us tease out the finer difference in the circumstances and pattern of injury if we are to design appropriate preventive measures.

Key Words: Brain injuries, falls, maxillofacial injuries, road traffic accidents, trauma

INTRODUCTION

Trauma patients undergoing head and neck computed tomography scan (CT scan) may have injuries ranging from clinically significant ones, such as displaced fractures, to subtle traumatic brain injury, such as concussions.[1] They may in some cases to have maxillofacial injuries as well.[6] Therefore, the CT scans done for ruling out cranial and brain injury if extended to cover the facial bones can be very useful quick references in diagnosing maxillofacial injuries without the need to take special regional scans. A report from Pakistan reported maxillofacial injury prevalence of up to 76% among patients with head injuries. A study in the UK reported only 14% patients with facial trauma as having a combination of cranial and/or brain injury in addition to maxillofacial injuries,[1] this figure is close to that reported from the emergency department of a Turkish hospital.[2] On the other hand, a study from Nigeria reported higher percentages of patients with maxillofacial injuries who also had head injuries at 55.8%.[3] These differences may be due to the uniqueness of the causes of injuries and protective gear use among the populations of the countries above.
It is worth noting that a study from Burkina Faso, a low-income country was similar to that from the UK, in prevalence of head and brain injury among maxillofacial trauma patients at 9.9%.\[^4\]

Worldwide, cranial cerebral injuries are a cause of death and disability due impairment of brain function and as such most centers will use all resources at their disposal to diagnose and treat these injuries.\[^3\] This is even more pertinent in resource-limited settings where cost and availability of diagnostic services such as CT scan are inhibitory yet the outcomes of brain injury are more severe.\[^6\] The face being in the same locality as the brain is likely to get injuries that may be missed when all the attention is focused on the head injuries. A study by Holmgren et al. had up to 7.9% patients who had had head CT scan brought in later for a maxillofacial one.\[^2\] It is imperative that facial injuries are picked as well since they too can cause death, malfunction, and serious disfigurement. However, this has to be done keeping cost and radiation exposure to a minimum.\[^9\] Thus, the usefulness of looking at the potential role of same sitting CT scan to evaluate head injuries along with facial and cervical injuries.

The CT scanning protocol at Mulago hospital for head trauma includes brain, head, facial bones and cervical spine. Thus, the stored information provided a good source of maxillofacial trauma patterns on CT scans.

Hence, this study aimed (i) to describe the occurrence of maxillofacial injuries among patients undergoing head and neck CT scan imaging following trauma (ii) to identify whether certain head injuries are associated with increased risk for given facial fractures patterns.

**METHODS**

This was a 1-year retrospective study (January 1, 2013–December 31, 2013) carried out in the department of Radiology Mulago Teaching and National Referral Hospital in Kampala, Uganda. The hospital is a 1500-bed unit located in Kampala and provides tertiary diagnostic, curative, rehabilitative, preventive, and teaching services. Waiver of consent was got from Makerere University School of Medicine higher degree and Ethics Committee.

The CT examination was performed using a Phillips MX16 (helical rotating system) at settings of 120 kVp, 220 mA, and 512 × 512 reconstruction matrix. The examinations were performed in axial view with coronal, sagittal, and three-dimensional reformats done on bone windows. The scanning covered head face and cervical areas as a routine standard procedure.

Data were obtained through a retrospective review of the images of adult trauma patients who underwent head CT scans at Mulago hospital. After excluding patient files with incomplete or unclear records and cases in which CT showed no evidence of injury, the files of 1200 patients with a diagnosis of head injury were included in the study. For each case, patient’s sex and age, pattern of facial fractures, and mechanisms of injury were recorded on a data sheet. The data were transferred to an SPSS (version 16.0; SPSS Inc., Chicago, IL, USA) spreadsheet for statistical analysis.

The mean age between males and females was compared using a simple student’s t-test. Proportions were computed and comparisons were done using a Chi-square test and the Fisher’s exact test. To establish the factors that determined the number of facial injuries, we carried out ANOVA tests then entered the significant variables into a model using multinomial logistic regression.

**RESULTS**

A total of 1330 trauma patients underwent head and neck CT scan in the 1-year study period. Out of these, 130 were excluded due to incomplete or unclear records and no evidence of injury. Of the remaining 1200, 32% (387) had maxillofacial fractures.

The median age of the patients with maxillofacial fractures was 28 (range = 18–80) years and 18–27 age group was most common at 47.5%. The male to female ratio was 12:1; however, there was no difference in median age between the two sexes, 28 (range = 18–73) and 27.53 (range = 18–80) years for male and female, respectively, \( P = 0.89 \). In addition, there was neither statistically significant difference between male and females and cause of injuries (\( \chi^2 = 6.65 \ P = 0.15 \)) nor was difference between age groups and cause significant (\( \chi^2 = 18.87 \ P = 0.09 \)).

Road traffic accidents (RTAs) (41.9%) were the main cause of trauma among patients with maxillofacial fractures. They were unfortunately followed by unknown causes as shown in Table 1. There was statistically significant relationship between the cause of injury and diagnosis of traumatic brain injury with road accidents causing most of brain injuries (\( \chi^2 = 13.19 \ P = 0.01 \)). Surprisingly, there was no significant difference between cause of injury and associated fractures (\( \chi^2 = 4.83 \ P = 0.30 \)).

Of the 387 patients with maxillofacial fractures at Mulago hospital, most injured were one bone followed by two, three, four, five, and six bones at 44%, 31%, 17%, 5%, 2%, and 1%, respectively. No statistical significance was noted in number of bones fractured and cause of accident.

The single most affected isolated bone was the frontal bone (23%) and the pattern was classified as depressed comminuted, nondepressed comminuted, and other at...
However, the Mulago hospital being in the main city of Uganda, with a number of young males involved in passenger motorcycle transport sector, these findings are not surprising at all. A case–control study from the Netherlands had falls as the number one causative factor and the median age stood at 42. This may be due to differences in weather, environment, and age distribution of the two countries. The high number of patients grouped as unknown causes in our study was due to the fact that many unconscious patients are brought by police patrol vehicles that dump them at the accident and emergency section without any information on the cause of injury. The female to male ratio is far higher than that reported in a Nigerian study. Mulago hospital being in the main city of Uganda, with a number of young males involved in passenger motorcycle transport sector, these findings are not surprising at all. A case–control study from the Netherlands had falls as the number one causative factor and the median age stood at 42. This may be due to differences in weather, environment, and age distribution of the two countries. The high number of patients grouped as unknown causes in our study was due to the fact that many unconscious patients are brought by police patrol vehicles that dump them at the accident and emergency section without any information on the cause of injury.

Just like Haug et al. and Salentijn et al., the frontal bone was the most injured bone in our study and this may be due to its prominence but may also be due to lack of helmet use among public transport motorcycle riders and commuters. These constituted the majority of patients reported in this study similar to an earlier study that looked at patient seen in the oral maxillofacial unit of Mulago hospital. In addition, since this was a cohort of trauma patients who had CT scan imaging of the head, it is very likely that the head impact was high enough to cause both brain injury symptoms and fractures to the skull bones. In fact 36% and 16.9% of our patient cohort had associated sphenoid and parietal bones fractures, respectively. Patients whose causes of fractures were due to falls suffered more injuries of the parietal bone (66.7%) as shown in Table 2. Of the 387 patients with maxillofacial injuries, 48.8% were associated with other skull bone fractures, 61.2% were associated with brain injuries, and 53.7% were diagnosed as open head injuries. Thirty-six percent (68/189) and 16.9% (32/189) were associated with the Sphenoid bone and Parietal bones fractures, respectively. Patients whose causes of fractures were due to assaults suffered more injuries of the frontal (61.8%) and maxillary (42.1%) bones. The ethmoid bones (77.8%) were more affected among patients who suffered falls. Patients whose causes of fractures were unknown had more injuries to the maxillary bones (49.3%) as shown in Table 2.

The number of maxillofacial bones fractured was predicted by age group (df = 3 F = 5.358, P = 0.001), association with other fractures (df = 1 F = 5.317, P = 0.03), sex (df = 1 F = 0.107, P = 0.74), cause (df = 4 F = 2.191, P = 0.69), and presence of frontal bone fracture (df = 1 F = 0.073 P = 0.79) were not significant predictors of number of facial fractures. The overall model fit Cox and Snell was $R^2 = 0.104$ and thus the model was; Prediction of number maxillofacial bone fracture = 100.3 + 133.4 (age group) +110.5 (association with other fractures).

## DISCUSSION

CT scan imaging has become the mainstay of investigation in head trauma due to its sensitivity and ability to pick up life-threatening or permanently disabling injuries. It has also proven very useful clinically for surgical planning and management of facial fractures. However, different centers adopt different protocols with some only taking the head and brain area while others include the maxillofacial and cervical area to screen for injuries. At Mulago hospital, the standing protocol is to include the maxillofacial region and cervical for every trauma head CT scan done. This provided us the advantage of being able to carry out this kind of research.

In the study, just like most, RTAs, male gender and below 30 years age groups contributed the highest number of patients in the respective categories. However, the male to female ratio is far higher than that reported in a Nigerian study. Mulago hospital being in the main city of Uganda, with a number of young males involved in passenger motorcycle transport sector, these findings are not surprising at all. A case–control study from the Netherlands had falls as the number one causative factor and the median age stood at 42. This may be due to differences in weather, environment, and age distribution of the two countries. The high number of patients grouped as unknown causes in our study was due to the fact that many unconscious patients are brought by police patrol vehicles that dump them at the accident and emergency section without any information on the cause of injury.

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In our study, there was a strong correlation between frontal bone fracture and brain injury (Pearson’s 393
Interestingly, 61.8% of patients whose injuries were caused by assault had frontal bone fractures, whereas the maxilla (53.1%) was the most affected among road traffic victims. The frontal bone being part of the upper face and relatively tough is not commonly injured among assault patients.\cite{14} Yet in our study, it was the most commonly fractured facial bone thus pointing to the unique assault mechanism in our setting. Many of these patients are hit using construction iron bars by robbers who usually go for the head to disable the victim with a single hit. This kind of assault produces different patterns from the interpersonal violence reported by other authors.\cite{19}

There was a slightly elevated risk for brain injury among patients who had more than two bones fractured at 1.2 (CI 0.9–1.5). Similar findings have been reported by other authors\cite{20} and as expected the injury that causes multiple fractures is sufficient to cause brain injury. However, some authors are of the view that the multiple facial fractures help dissipate the force reducing the actual residual energy and injury to the brain.\cite{21}

\[ P = 0.001 \]. Since this was a study done among patients who underwent head and neck CT scan imaging due to potential brain injury, it is not surprising that we had such a high prevalence of frontal bone fractures. In addition, in Kamulegeya et al.,\cite{17} 66% of the patients studied were involved in motorcycle accidents with as many as 90% not wearing helmets. This lends more credence to the risk of head injury with accompanying fractures among patients who do not use protective gears such as helmets and airbag systems as is often the case in Uganda. Therefore, it is imperative for us as a country to educate and enforce the use of protective gears for our road users since they have demonstrated efficacy in reducing injuries.\cite{18}
The number of facial bone fractures was predicated by age, association with other fractures, and presence of brain injury. This is testimony to the fact that the more severe the cause of trauma is, the higher the number of facial bone fracture. Likewise, the likelihood of brain injury and other associated fractures increases. The younger age group is expected to be more aggressive and wreckless thus increasing their chances of being involved in more severe accidents and assaults.

**CONCLUSIONS**

Good matched case–control prospective studies are needed to enable us tease out the finer difference in the circumstances and pattern of injury if we are to design appropriate preventive measures. In addition, a model that predicts who needs to have maxillofacial and cervical CT scan at the time of head CT would be of great help to clinicians and radiologists in saving time and money.

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**Conflicts of interest**

There are no conflicts of interest.

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