Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Radiological Sciences

Evaluation of Maxillofacial Trauma in Saudi Arabia using Computed Tomography

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DOI: 10.36347/sjams.2021.v09i08.013 | **Received:** 12.07.2021 | **Accepted:** 17.08.2021 | **Published:** 26.08.2021

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Abstract **Original Research Article**

Background: Trauma to the maxillofacial region can lead to severe complications such as sinuses obstruction, intracranial injuries, and vision loss. Computed tomography has a critical rule for early evaluation of the maxillofacial region. This study aimed to evaluate the findings that occur due to maxillofacial injuries using computed tomography (CT). ***Material and Method:*** A total of 200 facial CT patients were retrospectively examined, extending from January 2019 to January 2020. 140 slice CT systems (Siemens Medical system) were applied to investigate patients with maxillofacial trauma at three hospitals in Taif, Saudi Arabia. ***Results:*** Out of the 200 maxillofacial traumas, Maxilla fractures were found in 71 patients (35%), and Nasal fractures were found in 56 patients (28%). Various maxillofacial fractures were seen, including Frontal, Zygomatic, Ethmoidal, Mandible, Temporal, and Parietal and Orbital bone. The adults ranged from 20 to 39 years were more commonly affected; maxillofacial fractures were more prevalent in men. ***Conclusion:*** various maxillofacial fractures were identified during a facial CT scan, and approximately one-third were male. The maxilla bone was the most common site of the fracture, followed by the nasal bone. Therefore, CT is essential for the patient with maxillofacial trauma for early management to avoid any complications for the patient.

Keywords: Maxillofacial, Injuries, Trauma, Computed tomography, Fractures.

INTRODUCTION

Maxillofacial injuries are the results of low or high-energy trauma; the injuries can be life-threatening and lead to life-long disability if the injuries affect the orbits.

Either maxillofacial injuries are increasingly common among trauma patients in isolation or other serious injuries [1]. Maxillofacial injuries are a frequent cause of presentations in an emergency department. They are varying from simple, common nasal fractures to a gross combination of the face. The causes of maxillofacial trauma are diverse. The majority of them are due to motor vehicle accidents, particularly involving the facial bones, mandible, orbits, and adjacent soft tissue structures. Fall injuries, physical assault, and sports injuries account for a minor proportion of these patients [1-3]. Trauma to the maxillofacial region can lead to a sinus obstruction, intracranial injuries, loss of vision [4]. The maxillofacial region is one of the most complex anatomical structures of the human body, and the radiographic imaging of this region becomes further complicated in traumatic patients. Many radiological modalities can be used in the evaluation of traumatic maxillofacial patients. These include conventional radiography, Multidetector Computed Tomography (MDCT), Cone Beam Computed Tomography (CBCT), Orthopantomogram (OPG), and Magnetic Resonance Imaging (MRI)[1].

This study was designed to calculate the frequencies of maxillofacial injuries detected on the facial bone CT examinations. In addition, we wish to report the prevalence of these injuries and accentuate their clinical significance.

MATERIALS AND METHODS

Patients Selection and description

After receiving approval from the local ethical committee of the college of applied medical sciences, Taif University and directorate of health affair, Ministry of health, Taif, Saudi Arabia, a group of 200 patients 169 (84.5%) males and 31(15.5%) females with maxillofacial injuries, presenting at the CT departments of Al-Hada Armed Forces Hospital, King Faisal

Hospital, and King Abdul-Aziz Hospital Taif, Saudi Arabia, were recruited for this retrospective study over a period of two years (from January 2018 to January 2020). As per institutional policy, a waiver of informed consent was granted. The findings were categorized according to the site of fractures.

CT Facial examination protocol

Facial CT examinations were conducted on a 140 slice CT machine (Siemens Medical Systems, Munich, Germany) at the Al-Hada Armed Forces Hospital, King Faisal Hospital, and King Abdul-Aziz Hospital; the patient was in a supine position with head first. The CT technical parameters were 120 kVp, 60 mAs, and 2-3 mm slice thickness with identical reconstruction index.

Furthermore, the following image remonstrations were conducted for each patient: a three-dimensional volume rendering (VR) and two-dimensional multiplanar reconstruction (MPR).

Interpretation of CT images

Three consultants radiologist with ten years' experience diagnosed the obtained CT images. The following abnormalities were detected: i) Frontal bone fracture; ii) Zygomatic bone fracture; iii) Maxilla fracture; iv) Ethmoidal bone fracture; v) Nasal bone fracture; vi) Mandible fracture; vii) Pterygoid plate fracture; viii) Temporal bone fracture; ix) Parietal bone fracture; and x) Orbital bone fracture.

STATISTICAL DATA ANALYSIS

All Maxillofacial findings were expressed in a comparison table. Statistical analysis was performed using the Statistical Package for the Social Sciences version 16 for Windows (IBM Corporation, Armonk, NY, USA). Maxillofacial fractures were parenthetically detected during CT examination of the facial region were summarized as percentages and frequencies of cases.

RESULTS

In this retrospective study, a total of 200 traumatic patients' 169 (84.5%) males and 31(15.5%) females, were examined via facial CT and presented with various types of trauma. The findings have noticed that the maxillofacial fractures were significantly higher in the male population (84.5%) than the female population (15.5%) (Table 1).

Table-1: Prevalence of maxillofacial findings corresponding to patient gender (n=200)

Site of fracture	Gender	
	Male	Female
Frontal bone fracture	10	0
Zygomatic bone fracture	19	1
Maxillary bone fracture	55	16
Ethmoidal bone fracture	6	0
Nasal bone fracture	45	11
Mandible fracture	7	3
Pterygoid plate fracture	11	0
Temporal bone fracture	8	0
Parietal bone fracture	2	0
Orbital bone fracture	6	0
Total	169 (84.5%)	31 (15.5%)

Based on age groups, the incidence percentage of maxillofacial fractures was 33%, 47%, 11%, and 9% for age ranges 1-19 years, 20-39 years, 40-59 years, and 60-80 years, respectively (Figure 1).

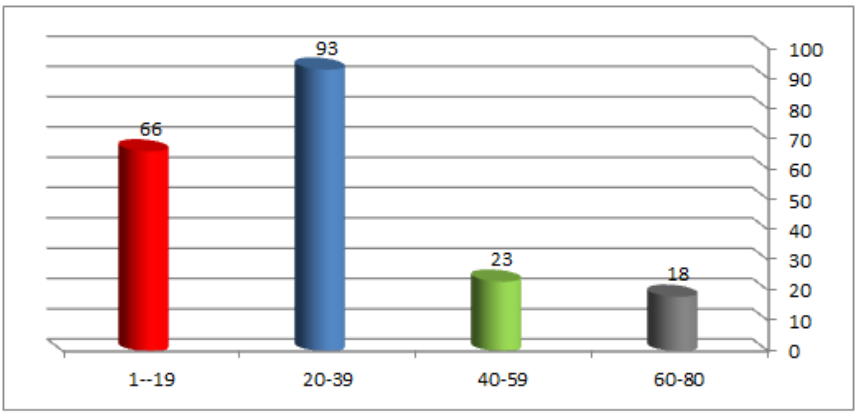

Fig-1: Prevalence of maxillofacial fractures corresponding to the age groups

Fig-2: 3D CT reconstruction for a 32-year-old male who had a history of previous surgical intervention at the left frontal region, status post gunshot demonstrates frontal bone fracture (Arrow)

In addition, the maxillofacial fractures were most likely related to maxillary bone (71; 35%) (Table 3 and Figure 2) and were more likely to affect the anterior wall of the maxillary bone. Nasal bone fracture (56; 28%) was the second most common maxillofacial fracture across CT scans of the facial bone (Table 3).

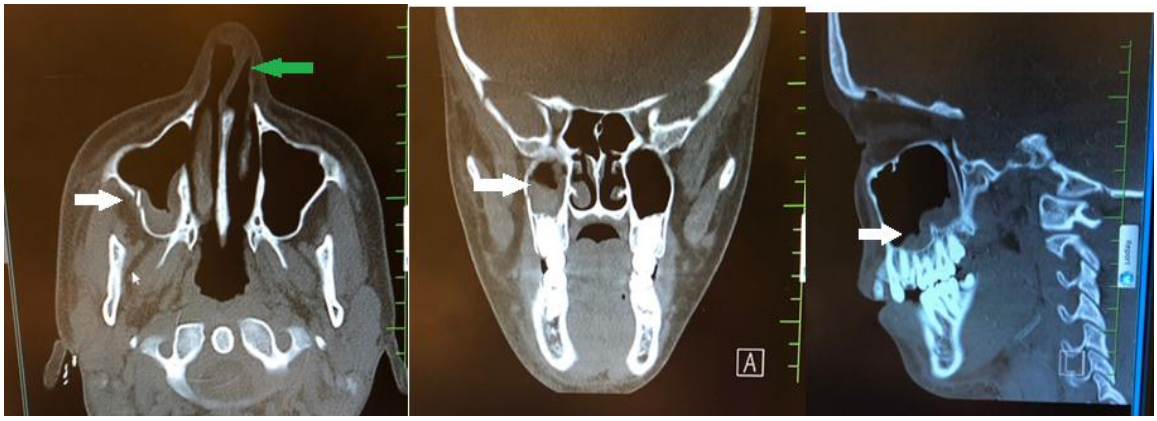

Fig-3: Axial, coronal, and sagittal views for a 26-year-old female show deviated nasal septum (Green arrow), opacification of the right maxilla, and fracture of the lateral wall (white arrows)

Table-3: Type of maxillofacial fractures (n=200)

Site of fracture	Frequency (n)	Percentage (%)
Frontal bone fracture	10	5%
Zygomatic bone fracture	20	10%
Maxillary bone fracture	71	35%
Ethmoidal bone fracture	6	3%
Nasal bone fracture	56	28%
Mandible fracture	10	5%
Pterygoid plate fracture	11	6%
Temporal bone fracture	8	4%
Parietal bone fracture	2	1%
Orbital bone fracture	6	3%
Total	200	100%

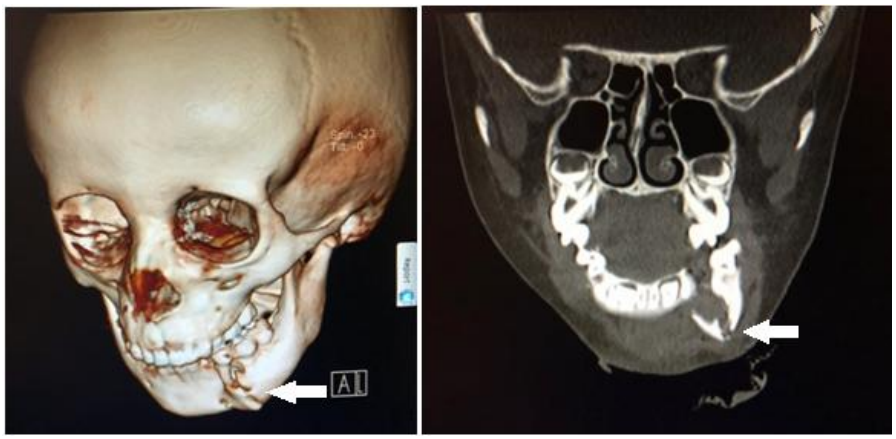

Fig-4: 3D and coronal views for a 9-year-old boy who is a post-traumatic case show left para symphyseal comminuted displaced mandibular fracture (Arrows)

DISCUSSION

Maxillofacial trauma has become one of the major health problems worldwide, and injury patterns vary in different societies. The maxillofacial region is one of the most complex regions in the human body [5]. Imaging this region becomes even more difficult in traumatized patients because of their clinical condition and inability to cooperate [6-8]. There is a discrepancy in the global incidence of facial fractures mainly due to the patient's age, socioeconomic status of the population investigated, geographical location, level of industrialization [9].

In our study, we evaluated the incidence of maxillofacial injuries in the Saudi Arabian population, and our results demonstrate that the road traffic accidents (RTA) accounted for the majority of causes of maxillofacial and mandibular injuries (73%), followed by physical assault (15%) and fall from height area (12%). Rix L *et al*. show that the most typical cause of maxillofacial injury in developed countries is road traffic accidents [10]. Our results agree with Rix L *et al*. regarding the causes of maxillofacial and mandibular injuries.

The key findings of this study were males constituted the higher number in maxillofacial trauma cases than females. This increased the incidence rate because there were no records for females that happened to have RTA injures, which was the majority type of trauma that causes a facial fracture. Furthermore, it could be due to the fact that females are less often involved in occupational or violence-related incidents, which are the typical causes of facial fractures.

In this study, the maxillofacial injuries were most common in the young population aged 1-19 years and 20-39 years. That is mean the facial fractures of all injuries were found to be common in young patients. The justification of these findings is that most adolescents turn to a number of potentially destructive behaviors to avoid or diffuse the intense negative emotions that accompany traumatic stress.

Further, In a study conducted by Simonds JS *et al*. [11] were noted that the most common fracture found was a mandibular fracture. However, maxilla was the most common middle third facial region fracture. Isolated posterior (10.22%) and inferior (5.6%) maxillary wall fractures are rare. They are commonly associated with mandibular fracture and may involve the temporomandibular joint (TMJ).

Other, study conducted by mohanavalli *et al*. [12] reported that the incidence rate of maxillary bone fractures was 41.9%.

Our findings on the incidence rate of maxilla fractures due to maxillofacial trauma were compatible with the results of Simonds JS *et al*. [11] and mohanavalli *et al*. [12], where they found maxilla fractures are the common fractures that occur in-patient with maxillofacial.

Furthermore, Mohanavalli *et al*. [12] reported that the incidence rates for mandible fractures, orbital fractures, and nasal bone fractures were (33.0%),(8.6%) and (6.4%) respectively. In contrast, the mandibular and orbital fracture incidence in the present study was 5% and 3%, respectively, lower than the percentages reported in the Mohanavalli study. In addition, our findings regarding nasal bone fractures were 28%, which is higher than the percentages reported in the Mohanavalli study.

These differences in incidence rates could be due to the smaller sample size compared to the other studies. Many studies have noted that three-dimensional reconstructed images are helpful in the evaluation of maxillofacial fracture displaced components, commination, and complex fractures involving multiple planes. In our study, the radiologists recommended that the extent of comminuted fractures is better to demonstrate on the volume rendering reconstruction,

where the shape, size, and displacement of individual fragments are revealed in multiplanar reconstruction (MPR). Moreover, the absence of free paranasal sinus fluid (clear sinus sign) in facial CT is a highly reliable criterion for excluding fractures involving the paranasal sinus wall. The post-processing reconstruction in CT scans allowed for excellent improvements in imaging interpretation.

The heterogeneity of the population limits our study because of the randomized selection process, which may influence the exactness of our outcomes and lessen the intensity of our conclusions. Other limitations of this study were: i) there was no second observer for any image interpretation used, meaning that the detection rate of inter-observer and intra-observer variability cannot be calculated; ii) there was a relatively small cohort sample size.

CONCLUSION

Our results revealed that the main cause of maxillofacial trauma was road traffic accidents, and males were more affected by maxillofacial trauma. In addition, the aged 1 to 39 years more often sustained maxillofacial injury. Finally, we recommended that volume-rendering reconstruction is better to evaluate maxillofacial trauma.

ACKNOWLEDGEMENT

The authors would like to thank all the staff of the radiology departments of Al-Hada Armed Forces Hospital, King Faisal Hospital, and King Abdul-Aziz Hospital, Taif, Saudi Arabia , without whom this study would not have been possible.

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