Original Article

Role of Computed Tomography in Evaluation of Maxillofacial Trauma

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ABSTRACT

Introduction: Facial injuries can occur due to road traffic accidents, falls, interpersonal conflicts, sports, or leisure activities. Radiological investigation helps to define the extent of injury and to plan the surgical, interventional, or conservative therapy. The purpose of the study was to determine the burden of fractures on computed tomography (CT) scan in maxillofacial trauma patients.

Methodology: A total of 100 maxillofacial trauma patients were evaluated by computed tomography. Fractures were registered and classified.

Results: Out of 100 patients, 83 patients sustained fractures. A total of 157 fractures were found in these patients. The most common fracture was mandibular followed by zygomaticomaxillary complex (ZMC) and zygomatic arch. The least common was naso orbito-ethmoid (NOE).

Conclusion: There is a high burden of fractures on CT scans in maxillofacial trauma patients.

Keywords: Computed tomography, Fracture, Maxillo-facial trauma.

INTRODUCTION

Injuries to the facial bones and adjacent soft tissues are very common in today's world. Facial injuries can occur due to road traffic accidents, falls, interpersonal conflicts, sports, or leisure activities. Trauma patients are usually subjected to radiological investigation. It helps to define the extent of injury and to plan the surgical, interventional, or conservative therapy.

After the vitals of a trauma patient are stabilized, the history has to be taken and a thorough clinical examination has to be performed. The fractures have their clinical features. Types of radiographs are advised based on clinical feature. For example, a simple tooth fracture is excellently detected on an intraoral periapical radiograph. As the severity of trauma increases, which is assessed by examining the patients, further higher radiographic techniques like an orthopantomograph, a submentovertex view, or a Water's view etc are considered. But all these views depict a two dimensional image of a three dimensional structure. The superimposition of other larger bony structures as well as the impaired visualization of fractures especially in small bones may dictate the use of further imaging modality.[1] In these conventional radio-graphs, the character of pattern on the radiograph formed by the anatomical structures of interest is partially or often sometimes even completely obscured by the shadows cast by the overlying or underlying structures. Radiological evaluation of facial injuries may be difficult due to the complex anatomy of the region. This is when a CT scan is of help as it completely eliminates the superimposition of images of structures superficial or deep to the area of interest and has inherent high-contrast resolution; differences between tissues that differ in physical density by less than 1% can be distinguished.[2] It would be appropriate to say that "the computed tomography (CT) revolutionized the field of imaging."

CT is the imaging technique of choice to detect and charac-

terize the number of fractures, fragments, the degree of dislocation, and the involvement of anatomical structures. It provides a three-dimensional (3D) mapping of the smallest fractures and abnormalities in a short period of time in trauma and emergency setting.[3,4]

The aim of the study was to document the burden and type of fractures by computed tomography to determine the location and reasonably assessing the fractures involving various bones of maxillofacial region and mandible and to document the causes of the trauma and correlate with the types of fractures.

METHODS

The study comprised of 100 maxillofacial trauma patients who visited the hospital and required CT. It was a retrospective hospital based study carried out for a period of 1 year and 11 months. The patient were selected randomly irrespective of age, sex, race, religion, and socioeconomic status and all patients with maxillofacial trauma and for whom CT was advised were included.

Equipment used for the study was OPTIMA CT 660 (GE Healthcare 3000 North Grandview Waukesha, WI 53188 USA). CT scans were done in supine position. Axial scans were taken and MPR was done in all the planes. A single X-ray source was used with 120 kvp and 235 MA tube current. The exposure time was 15-20 seconds. Single collimation width was 0.62 mm. Pitch factor was 0.53.

Fractures were classified into standard classifications. The cause of trauma was divided into following 5 categories[5]- road traffic accident (RTA), fall, sports injury, leisure activity injury, and assault.

RESULTS

There were 82 male patients and 18 female patients. Out of these, 69 males and 14 females had fractures. Out of 100 patients who underwent CT following maxillofacial trauma, 83 patients had fractures.

74 cases were of road traffic accidents (RTA) followed by 15 assaults, 9 falls, and 2 sports injuries. Maximum cases were of RTA (Figure 1).

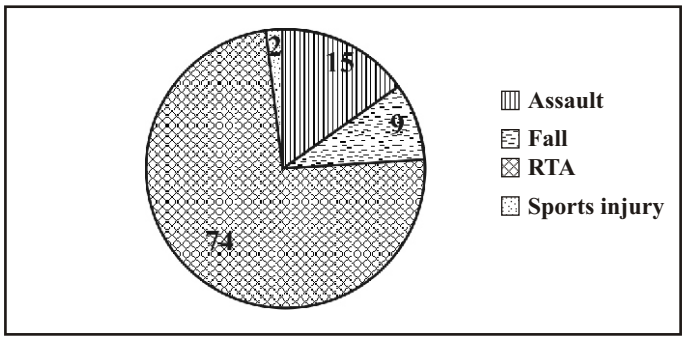

Figure 1: Pie diagram showing causes of fracture.

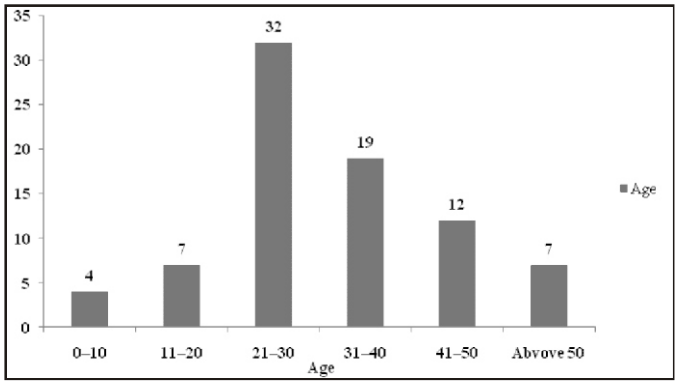

Figure 2: Bar diagram showing age distribution of the cases.

Table: Distribution of different types of maxillofacial fractures

Fracture	Number	Percentage (%)
Mandible	45	28.66
Palate	8	5.1
ZMC	30	19.11
Z Arch	24	15.27
Nasal bone	9	5.74
NOE	6	3.82
Orbit	7	4.46
Frontal	12	7.64
Le fort	8	5.1
Others	8	5.1
Total	157	100

ZMC: zygomaticomaxillary complex, Z arch: zygomatic arch, NOE: nasoorbitoethmoid.

The youngest trauma patient who sustained fracture was 2 years old and oldest was 65 years. Mean age being 31 years and a median age 27.5 years. The age groups 21 to 30 years and 31 to 40 years were most affected groups with fractures. The age group 0 to 10 was least affected (figure 2). The distribution of maxillofacial fracture are shown in table and the most common fracture found was mandibular fracture.

Burden of mandibular fractures according to Dingman and Natvig's classification[6] was 24.44% condylar/subcondylar fractures, 6.66% ramus and body each, 8.88% angle, 15.55% symphysis, and 37.77% parasymphysis. Prevalence of palatal fractures according to classification by Hendrickson[6] was 8, out of which three were type 1, one was type 2, and two each of type 3 and 4. Prevalence of zygomaticomaxillary complex fractures according to Rowe and Killey's classification[7] was 30 (19.10%). ZMC fractures were the second most common fractures in our study. Out of total thirty, there were fifteen type 8 i.e. comminuted fractures, six type 1, five type 3, two type 4, one each of type 5 and 2 fractures. Burden of zygomatic arch fractures according to classification by Rowe and William[7] was 24 (15.28 %). Out of these, thirteen were type 1, nine type 2, and two type 3. Burden of nasal fractures according to Haug and Prather's classification[6] was 9 (5.73%). Out of these, there were four type 1, two type 2, and three type 3 fractures. Burden of nasal orbitoethmoid fractures accord-ing to Markowitz and Manson's classification[6] was 6 (3.82%). There were four type 2 and one type 3 and 4 each. Burden of orbital fractures according to classification by Converse and Smith[7] was (74.45%), out of these three were type 1 and 3 each and one was both type 1 and 3. Burden of frontal bone fractures according to classification by Gonty et al[6] was 12 (7.64%). Out of these, eleven were type 2 and one type 3 fracture. Burden of Le fort fractures[6] was 8 which constituted 5.09% of the total fracture. There was one complete Le fort I, one unilateral Le fort I, two unilateral Le fort II, one complete Le fort III, and one unilateral Le fort III fractures. The other fractures constituted 5.09% which included two isolated maxillary sinus wall fractures, two parietal bone fractures, and two temporal bone fractures.

DISCUSSION

In the present study out of 100 patients, 83 had maxillofacial fractures. This was higher than in the study by Sohns et al.[5] In their study out of 784 patients, 470 (60%) sustained a fracture and 40% were free of bone injury. Their sample size was enormous as compared to ours but relative percentage of people who sustained fractures was less in their study. In CT examination, the radiation dose to the patient is greater than that which is required for standard radiography.[8]

In the present study, males outnumbered females by a great margin in having fractures. As men are involved in physical social altercations more often than women hence they are more prone to get injured than women. Also in this part of India i.e. in Sanganer tehsil, Jaipur, Rajasthan, more males drive vehicles as compared to females. Also as per Jaipur city census 2015, there are only 909 females per 1000 males.[9]

Maximum patients who sustained fractures were due to RTA (Figure 1). In a study by Sohns et al[5] 46% fractures were due to falls, 28% RTA, 15% assault, 4% leisure activity, 6% were unclear, and 1% other accidents at work. This study was carried out in Germany. In developed countries, the rate of RTA is less as they have a very good system of traffic rules and people abide by these rules. According to Akama et al[10] in most developing countries RTAs are the most common cause of maxillofacial trauma. In a study by Schaftenaar E et al,[11] road traffic accidents and assaults have been found to be the most common cause of maxillofacial trauma. Gassner R et al[12] conducted a study on 3,578 trauma patients during a period of 10 years. Only (12%) traffic accidents were seen in their study.

Assault was the second reason of fractures in the present study. 10.84% people had fractures due to assault. Females are marginally more prone to domestic violence. A study reported that assault following violent episodes, mostly in married couples was the most common cause of facial fractures.[13]

Falls contributed 7.22% of the fractures and the age group in falls was young children and old aged people who had more tendencies to fall and hurt themselves.

Sports injury contributed only 1.20% and from this we infer that sports are not being played much in our society instead of inferring that protective gears were used. There was not even a single case reported of leisure activity like adventure sports. This shows that people are not indulging

in leisure activities in this part of Rajasthan.

With proper knowledge on the causes of the facial fractures it becomes easy to plan evidence based programmes for community education on preventive measures.

Also, the most commonly fractured bone due to RTA was mandible which primarily involved parasymphysis and subcondylar region followed by ZMC and zygomatic arch as shown in the table. Le fort fractures were solely caused by RTA as a force of very high intensity is required to shatter the bones like the patterns in Le fort fractures. Due to fall and assault the most common fracture was mandibular fracture. Mandible is the easiest bone to be fractured by any trauma event due to its location and anatomy.

The age group 21 to 40 years reflect the greater physical activity and self mobility. The findings of the present study shows that young males in the age group 21 to 40 years sustained maximum fractures (Figure 2) following RTA and secondly due to interpersonal conflicts. Young children and old people had fractures following falls. Middle aged females sustained maximum fractures due to RTA followed by assault. Epidemiological assessments are essential to reaffirm patterns, identify new trends and develop clinical and research priorities for effective treatment and prevention of these injuries.[14]

The facial bones as a whole have a very low tolerance to impact forces. The nasal bones are least resistant, followed by the zygomatic arch and zygoma itself.[7] The position and anatomy of the mandible is such that it is most prominent and therefore, often the most likely fractured bone of the facial region. It is thin at the angles where the body joins with the ramus and the neck of condyle. The mental foramen through which mental nerve and vessels extend to the tissues of lateral aspect of the face and lower lip is large in some individuals and is an area of weakness through which fractures frequently occur. These factors contribute to the occurrence of high numbers of fractures of the mandibular symphysis, parasymphysis, angle, and condylar fractures.

Yamamoto et al[15] showed that the condyle (38.2%) was most frequently involved in the mandibular fracture. In ZMC fractures, radiographic examination may be the only determining factor for the presence and extent of injury, due to oedema obscuring the clinical features. Oedema masks the clinical features in an hour after the injury and may persist for nearly a week.[16]

CONCLUSION

There is a high burden of maxillofacial fractures in trauma patients and CT helps to visualize those fractures clearly. Due to the complex anatomy of the midface, CT is an important imaging tool and aids in detailed evaluation of maxillofacial fractures without the disadvantage of superimposition of overlying and underlying structures.

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