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Computer Tomography (Ct) in Maxillofacial Injuries (Mf-I)

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Dr Samarth Shah[1], Dr prakash Patil[2], Dr Asif Tamboli[3]

1Dept. of Radiology, Krishna institute of medical sciences, Krishna Vishwa Vidya peeth deemed to be university, karad (MS)
2,3Associate professor, Dept. of Radiology, Krishna institute of medical sciences, Krishna Vishwa Vidya peeth deemed to be university, karad (MS)

Keywords:

MF-I, CT, MDCT, Midface Area, RTA.

Abstract

MF-I is a truama in the facial area. It occurs mainly due to RTA, a fall, an attack, or a sports injury. It is mainly common in the midface area. Studies have proven that CT is a more reliable method to evaluate the same. Hence, in our study, we have aimed to to analyze the efficacy of CT in the assessment of MF-I. Therefore, we come to the conclusion that the utilization of MDCT is crucial in both the diagnosis and treatment planning of this particular injury. Furthermore, research needs to be done with a large sample size to validate the results of the study.

1. Introduction

MF-I refers to physical trauma that affects the facial region .This type of trauma is often associated with a high level of morbidity.[1] Its occurrence is mainly seen in both civilian and militarian. The primary etiological factors which contributes to MF-I is lack of preventive measures taken in traffic, leading to incidents of road traffic accidents [2] which is one of the leading cause in India.[1] Furthermore, there are five distinct anatomical regions of the face: the nasal, orbital, zygomatic, maxillary, and mandibular. These can be divided into 3 categories which includes single region, different regions & several contiguous regions.[3] Other reasons like sports injury , fall & animal attacks are included in mid-facial injuries.[4,5] Furthermore, to the best of our understanding, there is not much scholarly literature on the assessment of MF-1 through CT. Therefore, our study aimed to analyze the efficacy of computed tomography (CT) in the assessment of MF-I.

AIM

The goal of our study was to assess and evaluate the role of CT in the evaluation of MF-I.

INCLUSION CRITERIA

1. Patients who all have maxillofacial bone factures assed by CT scan.
2. Both male & females were included in the study.

EXCLUSION CRITERIA

1. Patients without any signs of maxillofacial bone facture.
2. Fracture of maxilla & mandible dento-alveoli.
3. Bone ailment & condition.

2. Materials & Method

The patients who reported to KIMS, Karad with signs of MF injuries & underwent CT evaluation for the same . In our study we have included total of 100 patients starting from December 2020 & to ending June 2022.

STUDY DESIGN- We have conducted an cross sectional type of study.

METHODOLOGY

In our cross sectional study , we have taken total of 100 patients who had MF-I underwent SIEMENS SOMATOM 16 slice CT evaluation. Each patient was investigated according to set protocol which includes well informed written consent , history of present injury, coronal-plane multiplanar reformation(MPR) images were also reconstructed alongside the axial imges with 0.75mm increment. Furthermore, three-dimensional volume rendering images were acquired. The MDCT scans were analyzed using a clinical workstation. The categorization of the fractures identified through the CT scan was based on the region that was affected. The comparison and evaluation of fracture identification,

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fracture extent, and displacement from 3D volumetric reconstruction (VR) images were conducted in relation to axial images. In order to facilitate the identification of fractures, a comparative analysis was conducted between axial and coronal images.

STASTICAL ANALYSIS

The data were processed by statistical software , count data were expressed as % & analysed by x2 test. P <0.05 suggested a statically significant difference.

3. Result

AGE DISTRIBUTION

AGE	Frequency	Percentage
11 – 20	9	9 %
21 – 30	37	37 %
31 – 40	27	27 %
41 – 50	13	13 %
> 50	14	14 %

In our study, we discovered that 100 of the patients ranged in age from 18 to 75 years. Out of which maximum number of patients were from 21 -30 years upto 37% of age group which was followed by 31-40 years of age group upto 27% whereas minimum number of patients were from 11 to 20 years of age group.

GENDER DISTRIBUTION

Gender	Frequency	Percentage
Males	**85**	85 %
Females	**15**	15 %

We found that , out of 100 patients maximum patients were males upto 85% , when compared to females upto 15% .

MODE OF INJURY

Mode of injury	No. of patients	Percentage
RTA	76	76 %
Fall from Height	11	11 %
Assault	13	13 %

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In our study we found that , maximum number of patient met RTA with 76 patients (76%) out of 100 patients which was followed by Assault upto 13 patients(13%) & fall from height upto 11 patients (11%) .

MF-I

1-FRONTAL BONE FRACTURE (FB –F)

In our study , all the patients 100 had undergone CT 3D image analysis ,wherein we were able to detect fracture , know extent of fracture , know the displacemnet distance of fracture in 3D against axial view & detect frcature in bone that is examined with coronal against axial view .

a-Detection of FB-F – 3D against Axial

	No. of patients	%
Inferior to axial image	4	11
Similar to axial image	10	26
Superior - Similar Information more rapidly assimilated	19	51
Superior - Additional Conceptiual informative Provided	4	12

b- Extent of FB-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	5	14 %
Similar to axial image	11	31 %
Superior - Similar Information more rapidly assimilated	13	34 %
Superior - Additional Conceptiual informative Provided	8	21 %

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c.Displacement of FB-F -3D against Axial

	No. of patients	Percentage
Inferior to axial image	5	14 %
Similar to axial image	12	34 %
Superior - Similar Information more rapidly assimilated	12	34 %
Superior - Additional Conceptiual informative Provided	8	22 %

d. Detection of FB-F – Coronal against axial

	No. of patients	Percentage
Inferior to axial image	0	0 %
Similar to axial image	30	82 %
Superior - Similar Information more rapidly assimilated	6	17 %
Superior - Additional Conceptiual informative Provided	1	1 %

In this study, we found that a higher percentage of patients 3D pictures improved the ability to detect and measure frontal bone fracture displacement. However, the 3D pictures did not sufficiently depict its spread, particularly into the posterior wall of the sinus or the roof of the orbit. In the detection of fractures in the frontal bones, coronal pictures were discovered to be comparable to axial scans.

2. ZYGOMATIC BONE FRACTURE (ZB-F)

In our study , all the patients 100 had undergone CT 3D image analysis ,wherein we were able to detect fracture

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, know extent of fracture , know the displacemnet distance of fracture in 3D against axial view & detect frcature in bone that is examined with coronal against axial view.

a.Detection of ZB-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	3	6 %
Similar to axial image	28	70 %
Superior - Similar Information more rapidly assimilated	14	24 %
Superior - Additional Conceptiual informative Provided	0	0 %

b.Extent of ZB-F-3D against axial

	No. of patients	Percentage
Inferior to axial image	5	10 %
Similar to axial image	31	56 %
Superior - Similar Information more rapidly assimilated	19	34 %
Superior - Additional Conceptiual informative Provided	0	0 %

c.Displacement of ZB-F-3D against Axial

	No. of patients	Percentage
Inferior to axial image	4	8 %
Similar to axial image	2	4 %
Superior - Similar Information more rapidly assimilated	29	51 %

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Superior - Additional Conceptiual informative Provided	20	37 %

d.Detection of ZB-F- Coronal against axial

	No. of patients	Percentage
Inferior to axial image	2	4 %
Similar to axial image	41	75 %
Superior - Similar Information more rapidly assimilated	12	21 %
Superior - Additional Conceptiual informative Provided	0	0 %

The present investigation reveals that 3D scans are equivalent to or superior to traditional methods in diagnosing and characterizing extension in the majority of patients with zygomatic bone fractures. In the majority of cases, it has been found that it is more efficacious to employ alternative imaging techniques rather than axial pictures for evaluating displacement. Both axial and coronal scans demonstrated high efficacy in detecting zygomatic bone fractures.

3.NASO-ORBITO-ETHMOID FRACTURE (NOE-F)

In our study , all the patients 100 had undergone CT 3D image analysis ,wherein we were able to detect fracture , know extent of fracture , know the displacemnet distance of fracture in 3D against axial view & detect frcature in bone that is examined with coronal against axial view.

a-Detection of NOE-F-3D against axial

	No. of patients	Percentage
Inferior to axial image	62	79 %
Similar to axial image	10	13 %
Superior - Similar Information more rapidly assimilated	7	8 %
Superior - Additional Conceptiual informative Provided	0	0 %

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b-Extent of NOE-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	66	84 %
Similar to axial image	6	8 %
Superior - Similar Information more rapidly assimilated	7	9 %
Superior - Additional Conceptiual informative Provided	0	0 %

c. DISPLACEMENT OF NOE-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	66	84 %
Similar to axial image	9	11 %
Superior - Similar Information more rapidly assimilated	4	5 %
Superior - Additional Conceptiual informative Provided	0	0 %

d.detection of NOE-F –Coronal against axial

	No. of patients	Percentage
Inferior to axial image	2	3 %

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Similar to axial image	20	26 %
Superior - Similar Information more rapidly assimilated	27	33 %
Superior - Additional Conceptiual informative Provided	30	38 %

The current study has demonstrated that, in the case of most patients, axial scans were superior to 3D images in identifying, measuring, and determining the displacement of fractures in the naso-orbito-ethmoid region. The superiority of coronal imaging over axial scans in the detection of fractures in the orbital region, specifically those situated in the medial wall and floor, has been demonstrated.

4. FRACTURE IN MAXILLA BONNE (MB-F)

In our study , all the patients 100 had undergone CT 3D image analysis ,wherein we were able to detect fracture , know extent of fracture , know the displacemnet distance of fracture in 3D against axial view & detect frcature in bone that is examined with coronal against axial view.

a.Detection of MB-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	9	12 %
Similar to axial image	41	53 %
Superior - Similar Information more rapidly assimilated	27	35 %
Superior - Additional Conceptiual informative Provided	0	0 %

b. Extent of MB-F -3Dagainst axial

	No. of patients	Percentage
Inferior to axial image	52	68 %
Similar to axial image	20	26 %

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Superior - Similar Information more rapidly assimilated	5	6 %
Superior - Additional Conceptiual informative Provided	0	0 %

c.Displacement of MB-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	36	47 %
Similar to axial image	26	34 %
Superior - Similar Information more rapidly assimilated	10	13 %
Superior - Additional Conceptiual informative Provided	5	6 %

d. Detection of MB-F – coronal against axial

	No. of patients	Percentage
Inferior to axial image	5	6 %
Similar to axial image	46	60 %
Superior - Similar Information more rapidly assimilated	26	34 %

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Superior - Additional Conceptiual informative Provided	0	0 %

In our study we found that, utilization of 3D scans was more effective in detecting maxillary fractures, especially when the front wall of the sinus was affected. Nevertheless, the utilization of axial images yielded a superior perspective regarding the extent of engagement and its displacement. The efficacy of axial scans and coronal imaging in detecting maxillary fractures was found to be comparable in the majority of patients.

5. FRACTURE IN MANDIBLE (MAND –F)

In our study , all the patients 100 had undergone CT 3D image analysis ,wherein we were able to detect fracture , know extent of fracture , know the displacemnet distance of fracture in 3D against axial view & detect frcature in bone that is examined with coronal against axial view.

a. Detection of MAND-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	6	19 %
Similar to axial image	9	30 %
Superior - Similar Information more rapidly assimilated	14	51 %
Superior - Additional Conceptiual informative Provided	0	0 %

b. Extent of MAND-F-3D against axial

	No. of patients	Percentage
Inferior to axial image	5	17 %
Similar to axial image	11	36 %

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Superior - Similar Information more rapidly assimilated	13	47 %
Superior - Additional Conceptiual informative Provided	0	0 %

c. Displacement of MAND-F -3D against axial

	No. of patients	Percentage
Inferior to axial image	3	11 %
Similar to axial image	4	14 %
Superior - Similar Information more rapidly assimilated	14	50 %
Superior - Additional Conceptiual informative Provided	8	25 %

d. Detection of MAND-F –coronal against axial

	No. of patients	Percentage
Inferior to axial image	2	8 %
Similar to axial image	18	64 %
Superior - Similar Information more rapidly assimilated	6	17 %

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Superior - Additional Conceptiual informative Provided	3	11 %

The present study revealed that the determination of identification and involvement extent in the majority of individuals with mandibular fractures was comparable between 3D and axial imaging techniques. Utilizing three-dimensional images for evaluating the displacement of fractured fragments presents a distinct advantage. Both axial and coronal scans were effective in detecting mandibular fractures.

DISTRIBUTION OF FRACTURES DETECTED IN MAXILLOFACIAL REGION

Sr.No.	Type Of Bone	Occurence Of Fractures	Percentage of patients
1.	Frontal bone fracture	37	37 %
2.	Zygomatic bone fracture	55	55 %
3.	Naso-orbito-ethmoid bonefracture	79	79 %
4.	Maxilla bone fracture	77	77 %
5.	Mandible bone fracture	29	29 %
6.	Pterygoid Plate fracture	21	21 %
7.	Sphenoid wing	32	32 %
8.	Temporal bone	18	18 %
9.	Parietal Bone	6	6 %

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The findings of the study indicate that the NOE region was the predominant site of fracture, accounting for 79% of all occurrences. The bone that was predominantly affected in patients was the maxilla, particularly the walls of its sinus, with a fracture being observed in 77% of cases. In the patient cohort, it was observed that 55% and 37% of individuals had fractures of the zygomatic and frontal bones, respectively. Of the five main facial components analyzed, mandibular bone fractures had the lowest occurrence rate, affecting only 29% of the participants. The findings of the study indicate that in 21 cases, representing 21% of the sample, the pterygoid plates were observed to be implicated. Sphenoid wing involvement was observed in 32 cases, representing 32% of the total cases. The findings of the research indicate that 18% and 6% of the patents analyzed exhibited the presence of the temporal and parietal bones, respectively.

ASSOCIATED FINDING

Associated findings	Occurrence	%
Hemosinus	85	85
Contusions	13	13
SAH	4	4
SDH	9	9
EDH	13	13
Pneumocephalus	12	12

In our study ,the most frequent concomitant finding in patients who had facial injuries was hemosinus. 85 patients (85 %), experienced it. The next frequent finding was brain contusions, which were present in 13 (13%) of the patients. Twelve (12%) patients had pneumocephalus. There were additional intracranial problems such EDH, SDH, and SAH in 13 (13%), 9 (9%) and 4 (4%) individuals, respectively.

FRONTAL BONE INJURIES

Fracture type	No. of fractures (n=37)	Percentage
Type I	6	16 %
Type II	12	32 %
Type III	9	26 %
Type IV	6	16 %
Type V	4	10 %

In our study we found that , type 2 frontal bone fractures were more frequently observed 12 (32%) times. The next most prevalent form is type 3, which occurs 9 (26%) times. Each fracture of type 4 and type 1 was observed six times (16%). The injury type 5 was the least frequent, occurring four times (10%).

ORBITAL INJURY

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Orbital injury	No. of fractures (n=158)	Percentage
Superior wall (Roof)	27	17 %
Medial wall	33	21 %
Lateral wall	40	24 %
Inferior wall (Floor)	58	38 %

In our study we found that , in 58 (38%) of the total orbital injuries found, the lateral wall of the orbit was most frequently damaged. 40 instances (24%) of the orbital floor were observed to be affected. There were 33 (21%) and 27 (17%) instances of medial wall and roof involvement, respectively.

MANDIBULAR INJURY

Mandible injury	No of fractures (n=62)	Percentage
Angle	4	6 %
Body	20	32 %
Condyle or neck	7	11 %
Parasymphyseal region	11	19 %
Ramus	8	13 %
Coronoid process	5	8 %
Alveolar ridge	7	11 %

In our study we have found that the body of the mandible suffered mandibular injuries the mostly. 20 fractures were discovered in the body, accounting for 32% of the 62 fractures found in the mandible. 11 (19%) of the mandibular fractures had parasymphyseal area fractures. Eight (13%), seven (11%), and seven (11%) of the fractures, respectively, were identified to have ramus fractures, condyle or neck fractures, and alveolar ridge fractures. Coronoid process fractures occurred 4 times (6%) and 5 times (8%) respectively.

LE FORT FRACTURE LINES

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Le Fort Fracture Lines identified	No. of Fractures (n=24)	Percentage
Le Fort I	6	25
Le Fort II	11	46
Le Fort III	7	29

In our study we have found that ,Le Fort fracture lines were discovered 24 times. Le Fort II, which appeared 11 times (46 %), was the most frequent Le Fort line identified. Le Fort I was noted six (25 %) times, and LeFort III fracture lines were noted 7 (29 %).

4. Discussion

MF trauma may present as either isolated injuries or as a component of polytrauma. These injuries hold significant clinical relevance due to the resultant asymmetry and disfigurement of the facial soft tissues and bones, which can have a profound impact on the patient's psychological well-being and physical appearance. Additionally, the region is intricately linked to other crucial daily functions.[6] Furthermore, although CT had higher radiation dose than traditional radiography, yet this imaging technique is a choice for determining the number of fragments, the extent of rotation and displacement, or any involvement of the skull base.[7]

Age

In our study , we found that most of the cases were from 21 to 30 & 31 to 40 age group with 37% & 27% respectively.

Gender

In our study ,we found that maximum number of patients were male upto 85% & remaining were females. A similar study found that similar results wherein 80% were male patient with MF-I.[8]

Mode of Injury

In our study we found that, maximum number of patient met RTA with 76 patients (76%) out of 100 patients which was followed by Assault upto 13 patients(13%) & fall from height upto 11 patients (11%) . Furthermore, numerous other studies have also found that , most common reason for facial fractures was automobile accidents.[9,10,11]

MF-I

Frontal bone fracture

The study reveals that the implementation of 3D imaging resulted in a significant increase in the detection and displacement of frontal bone fractures among a larger proportion of patients. Nevertheless, the 3-dimensional images were inadequate in illustrating the full scope of the condition, specifically in regards to the posterior sinus wall or the orbit roof. The restricted visual access in the sinus can be attributed to the overlapping of its bony anterior wall. Research has demonstrated that both axial scans and coronal images exhibit similar levels of efficacy in identifying fractures in the frontal bones.

ZB-F

The study conducted has revealed that the utilization of 3D scans has demonstrated comparable or superior efficacy in diagnosing and characterizing extension in the majority of patients afflicted with zygomatic bone fractures. In the majority of cases, it was found that it is more efficacious to evaluate displacement using a method other than axial images. Both axial and coronal scans demonstrated high efficacy in detecting zygomatic bone fractures.

NOE -Region

The present study has revealed that the utility of 3D images in ascertaining the detection, extent, and

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displacement of fractures in the naso-orbito-ethmoid region was comparatively lower than that of axial scans in most of the subjects. Coronal scans were found to be more effective than axial imaging in detecting fractures in the floor and medial wall of the orbit within the region.

MB-F

It has been determined that the utilization of 3D scans is more effective in detecting maxillary fractures, especially when the frontal wall of the sinus is implicated. Nevertheless, the utilization of axial images yielded a superior perspective regarding the extent of engagement and its displacement. In the majority of cases, coronal scans demonstrated equivalent or superior efficacy compared to axial imaging for the detection of maxillary fractures in patients.

Orbital Injury

In our study we found that , in 58 (38%) of the total orbital injuries found, the lateral wall of the orbit was most frequently damaged. 40 instances (24%) of the orbital floor were observed to be affected. There were 33 (21%) and 27 (17%) instances of medial wall and roof involvement, respectively. Furthermore, studies of orbital fractures have frequently included medical wall & floor in their investigations.[12,13,14]

LeFort

In our study we have found that ,Le Fort fracture lines were discovered 24 times. Le Fort II, which appeared 11 times (46 %), was the most frequent Le Fort line identified. Le Fort I was noted six (25 %) times, and LeFort III fracture lines were noted 7 (29 %).

5. Conclusion

MF-I are frequently occurring and urgent cases that require timely identification and immediate treatment. The principal objective of diagnostic imaging is to accurately detect and localize facial fractures while also differentiating them from soft tissue injuries in order to facilitate optimal treatment strategies. The utilization of MDCT is crucial in both the diagnosis and treatment planning of this particular injury. Notwithstanding certain limitations, such as a restricted sample size and the infrequent incidence of maxillofacial trauma, further investigation involving a more extensive sample size is imperative to establish conclusive findings.

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