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Evaluation of Maxillofacial Injuries by Multi-Detector Computed Tomography -A Hospital Based Cross Sectional Study

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ABSTRACT

BACKGROUND:

Maxillofacial trauma (MFT) is one of the most common emergencies encountered in the emergency department. Early and accurate diagnosis is crucial for optimal patient management. This study helps us to understand the role of computed tomography in the detection of simple and complex maxillofacial injuries and further helps in appropriate treatment. This study also focuses on the role of multiplanar reconstruction (MPR) and 3D reconstruction techniques in the comprehensive assessment of maxillofacial injuries.

OBJECTIVE:

To describe the fractures according to the bones involved in the evaluated patients and to evaluate the advantages of 3D and coronal reformatted images over axial images in various facial fractures.

METHODS:

Hospital-based cross-sectional observational study was carried out over a period of 18 months on patients referred to the Department of Radiodiagnosis, Adichunchanagiri Hospital and Research Centre, B G Nagara. Axial CT with multiplanar reconstruction was performed in patients who were referred to the department of Radiodiagnosis for MDCT in case maxillofacial trauma

RESULTS:*(Out of 100 patients studied)*

- *The majority of patients (45.0%) were in the age group of 21-40 years, followed by 40.0% in the 41-60 age group.*
- *Road traffic accidents (64.0%) were the leading cause of maxillofacial trauma, followed by self-fall injuries and assaults. (36.0%).*
- *MPR and 3D imaging effectively detected and assessed naso-orbito- ethmoidal fractures (63.0%), maxillary fractures (67.0%), frontal bone fractures (35.0%), and mandible fractures (37.0%).*
- *Le Fort fractures were identified in 12 patients.*

CONCLUSION:

MDCT remains an essential diagnostic tool for evaluating maxillofacial injuries offering high accuracy and reliability. 3D imaging plays a crucial role in detecting and assessing fractures, particularly in complex cases. The study findings align with existing literature, emphasizing the importance of MDCT in trauma assessment. The prevalence of intracranial hemorrhage highlights the need for careful evaluation in trauma cases.

INTRODUCTION

Maxillofacial trauma (MFT) is among the most common emergencies in the emergency department. Post-traumatic maxillofacial injuries are fairly common, and these injuries can affect a patient's aesthetic, functional, and psychosocial activities if not managed properly.

Facial injuries can occur to the dentition or maxillofacial skeleton alone or in combination with cervical, multisystem, or skull fractures. The face is the most exposed part of the body and the most prone to trauma. Nowadays, trauma is the major cause of death for people under the age of 40. Interpersonal violence, falls, road traffic accidents, and sports injuries are the leading causes of maxillofacial fractures reported worldwide.

The prevalence of maxillofacial injuries varies between 17% and 69%, and this large difference may be due to various environmental factors, socioeconomic conditions, cultural influences and traffic restrictions.

Conventional radiographs are relatively sensitive for the fractures of the cranial vault, but insensitive to fractures of the base of the skull and the facial skeleton. CT allows accurate diagnosis of all types of fractures of the facial skeleton and base of the skull. It provides additional information regarding intracranial hemorrhage and cerebral injury.

In pan-facial trauma patients, the CT evaluation can be expanded to include the cervical spine, if necessary. Conventional X-rays of the skull are no longer indicated in traumatic brain injury or polytrauma patients.

METHODS

A hospital based cross-sectional study carried out over a period of 18 months at Adichunchanagiri Hospital and Research Centre, B G Nagara.

Source Of Data : All patients referred to the department of Radiodiagnosis for MDCT in case maxillofacial trauma according to ATLS protocol were included in this study.

Study Design: A hospital based cross sectional study

Study Settings: Radiodiagnosis department, Adichunchanagiri Institute of Medical Sciences, Bellur.

Duration of the Study: 18 months (June 2023- Nov 2024)

Inclusion Criteria:

All patients with clinical evidence of maxillofacial injuries who underwent multidetector CT examination and were found to have fractures

Exclusion Criteria:

1. Patients with maxillofacial injuries in whom a CT examination is contraindicated. (e.g.: Pregnancy).
2. Previous history of maxillofacial injuries.

SAMPLE SIZE ESTIMATION

Scientific basis of sample size used in the study:

Based on the previous article "Prevalence, pattern, etiology, and management of maxillofacial trauma in a developing country: a retrospective study", Standard deviation was obtained and sample size was calculated using following formula

$$n = \frac{(Z_\alpha + Z_\beta)^2 \times \sigma^2}{d^2}$$

- the size of the effect that is clinically worthwhile to detect (d) = 10
- the probability of falsely rejecting a true null hypothesis (α) = 0.05, $Z_\alpha = 1.96$
- the probability of failing to reject a false null hypothesis (β) = 0.80, $Z_\beta = 0.84$

the standard deviation of the population being studied (SD or σ) = 35*

Sample size: 100

Sampling technique used: Convenient sampling.

METHOD OF DATA COLLECTION:

This **cross-sectional study** was conducted at the **Department of Radiodiagnosis, Adichunchanagiri Institute of Medical Sciences**, B.G. Nagara, Mandya, Karnataka, over a period of 18 months. It included **100 consenting patients** of all ages and sexes with clinical suspicion of maxillofacial injuries for **CT Head**. Patients with contraindications to CT scanning (e.g., pregnancy) or with a prior history of maxillofacial injuries were excluded. CT scans were performed on a **GE Revolution Maxima,** supine axial sections with 5mm slice thickness were taken and reformatted to thin sections, Multiplanar and 3D reformation were also done and images were assessed.

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STATISTICAL ANALYSIS

After being coded, the gathered data was added to an Excel document on Microsoft. An analysis was done on the data. The outcomes were evaluated. Different rates, ratios, and percentages were computed for qualitative data. When it came to continuous variables, the data were given as mean and standard deviation (SD) for normally distributed variables and by median (Min - Max) for non-normally distributed variables. The data on categorical variables were displayed as n (% of cases). Together, the data were presented in both tabular and graphical form to highlight the study's significance.
The statistical package for Social Sciences (SPSS ver. 24.0, IBM corporation, USA) for Microsoft windows is used to statistically analyze all the data.

RESULTS

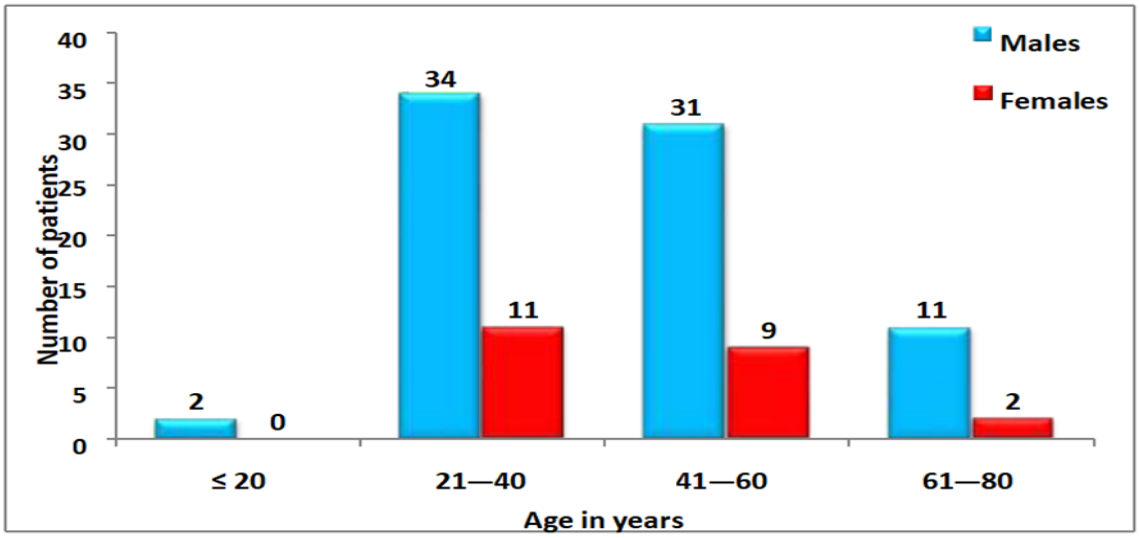

Figure 1: Multiple bar diagram represents age and gender wise distribution of patients
The study findings reveal that the majority of patients, 45 (45.0%), were in the age group of 21-40 years. Following this, 40 (40.0%) patients belonged to the age group of 41-60 years, while 13 (13.0%) patients were in the age group of 61-80 years. Additionally, 2 (2.0%) patients were under the age of 20 years.
The youngest patient observed was 2 years old, while the oldest patient was 75 years old. The average age of male patients was 43.26 years, and for female patients, it was 44.68 years.

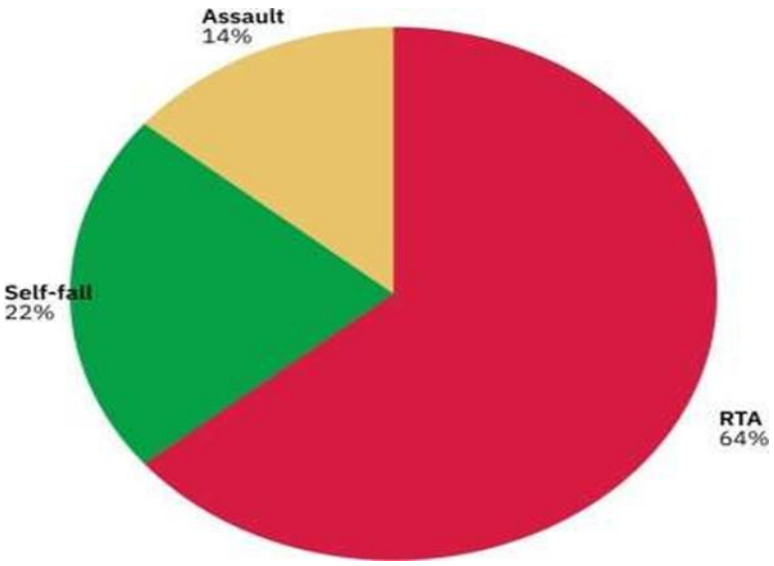

Figure 2: Mode of injury wise distribution of patients

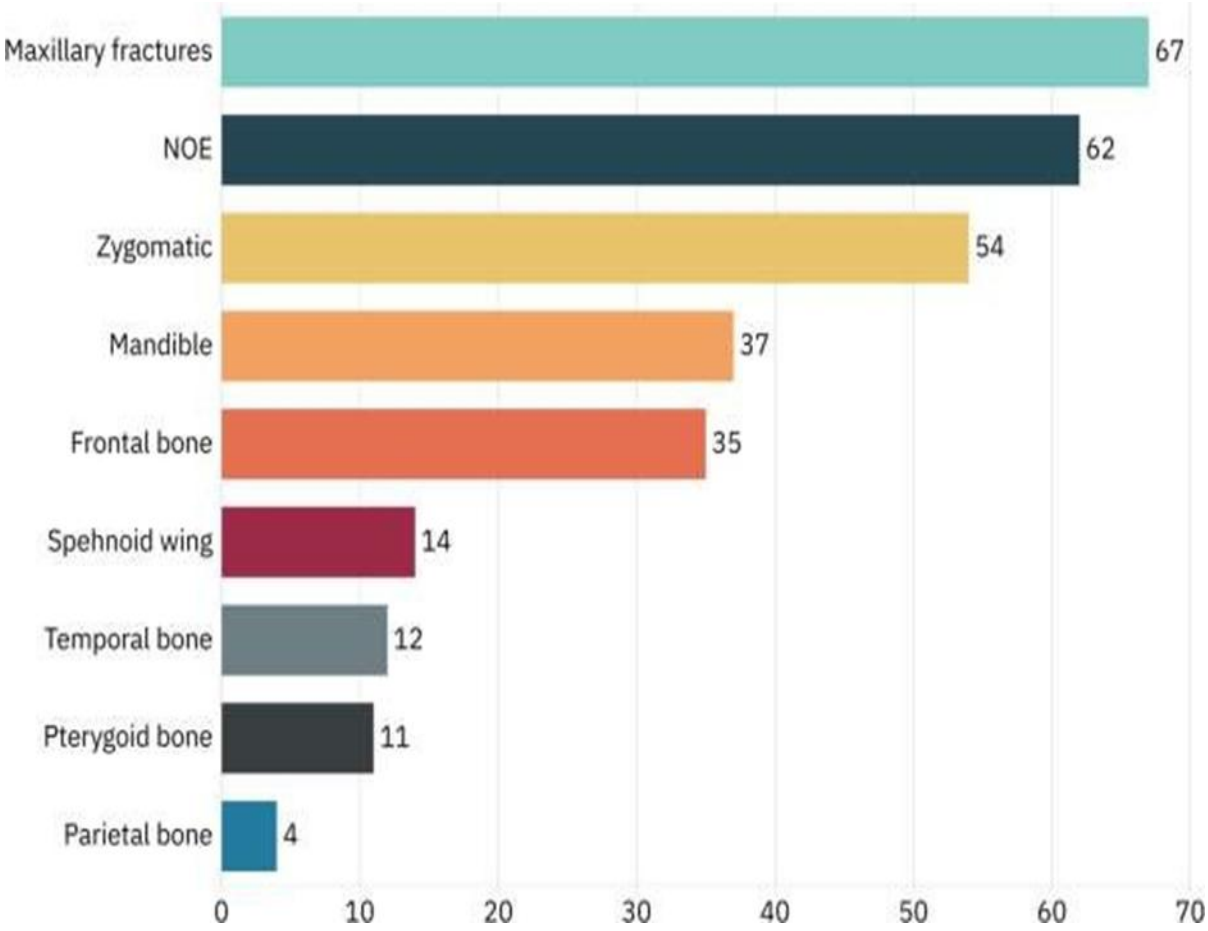

Figure 3: Bar diagram represents no of patient's evaluated fractures according to the bones involved

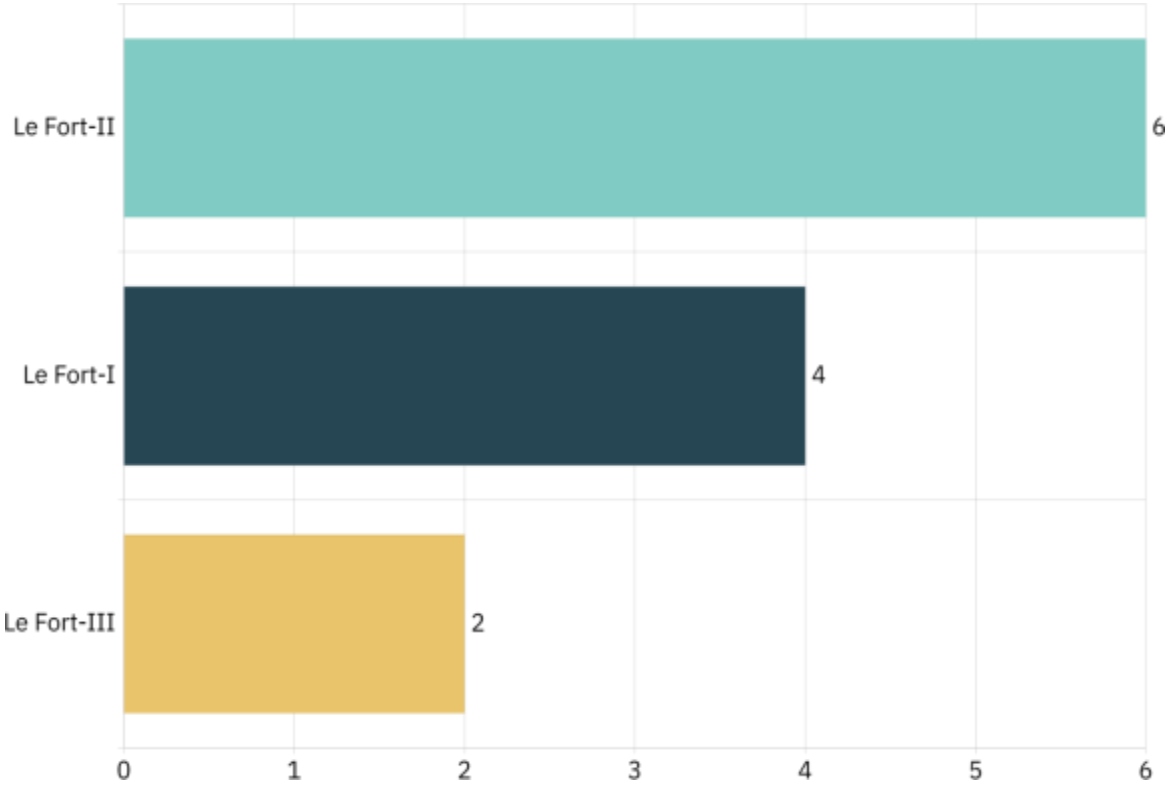

Figure 4: Bar diagram represents Le Fort Fracture Lines Identified

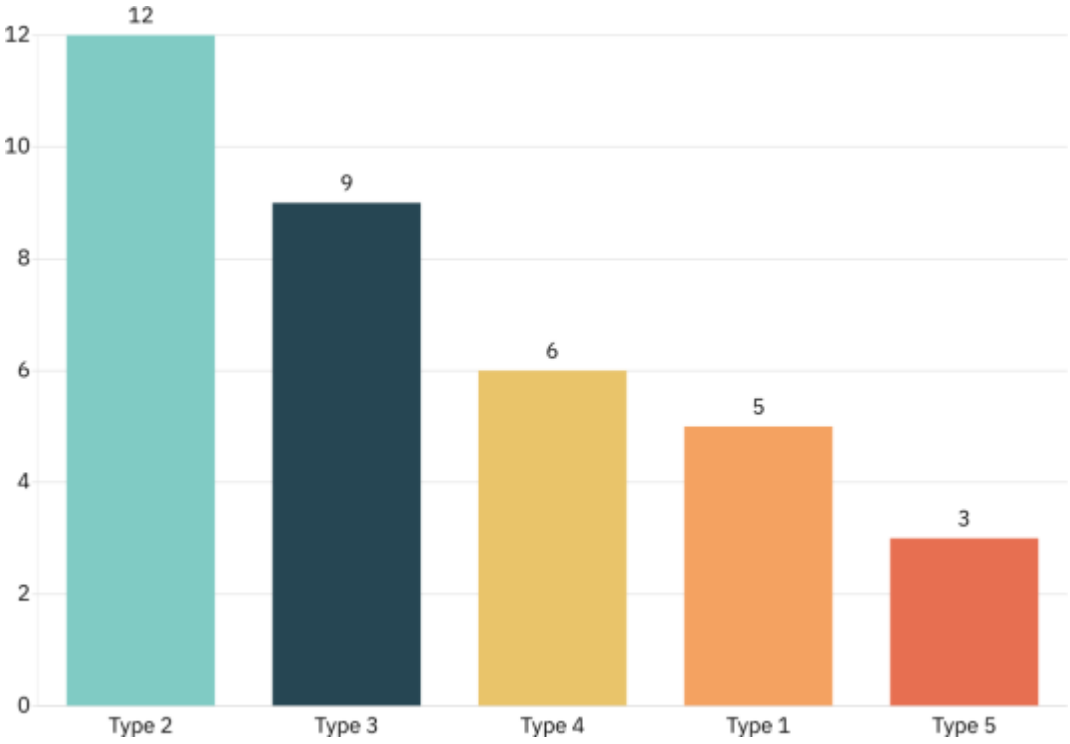

Figure 5: Bar graph showing frontal bone fractures based on Manolidis classification.

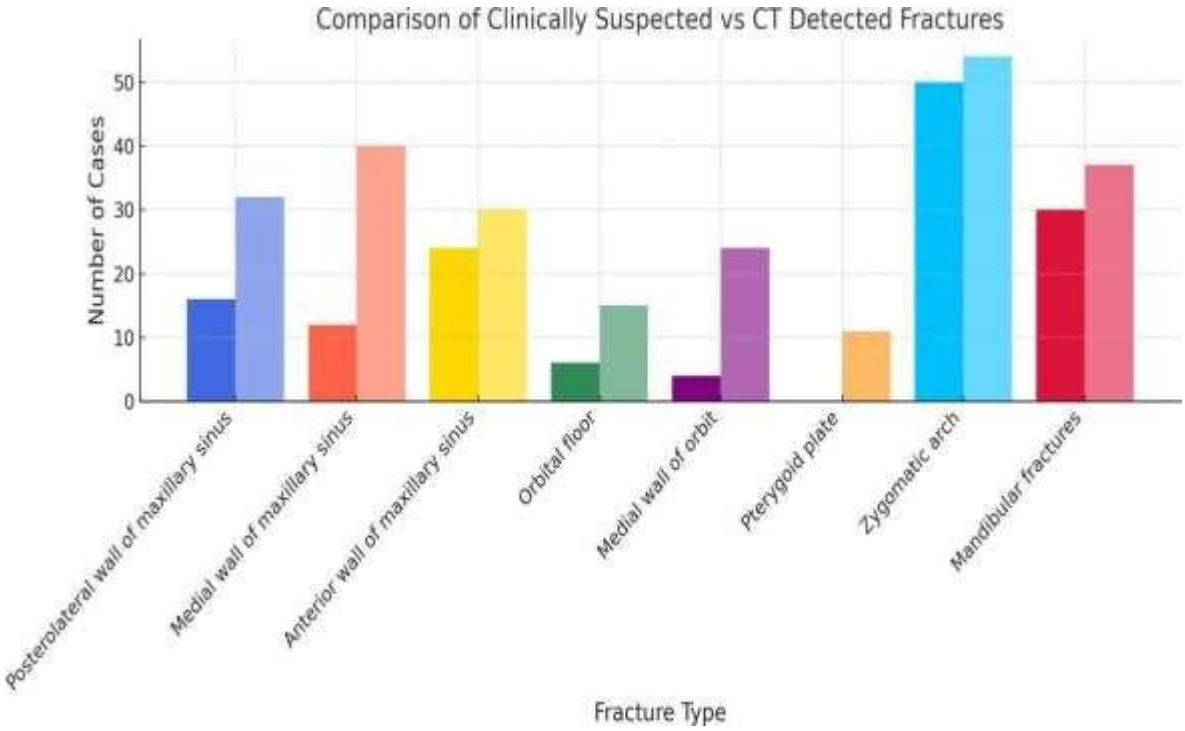

Figure 6: Bar graph showing comparison between clinically suspected vs fractures detected on CT scan.

DISCUSSION

This was a cross-sectional, observational study performed to evaluate role of MDCT in the assessment of Maxillofacial injuries.

Our study revealed that out of 100 sample patients, the predominant cause of maxillofacial trauma was road traffic accidents (RTA), accounting for 64 patients (64.0%). Self-fall and assault together contributed to 36.0%.

Our study revealed that the majority of patients had maxillary fractures (67%), followed by Naso-orbito-Ethmoidal fractures (62%). 54% of patients had zygomatic bone fractures. Mandibular fractures were involved in 37% of the patients and frontal bone in 35% of the patients.

3D imaging proved more effective in detecting frontal bone fractures and assessing displacement in a higher percentage of patients. However, it was less reliable in evaluating fracture extensions, particularly into the posterior wall of the sinus or the orbital roof.

Coronal images demonstrated similar accuracy to axial images in identifying frontal bone fractures.

For zygomatic bone fractures, 3D imaging was comparable to or better than other modalities in detecting fractures and assessing their extent. It also outperformed axial images in evaluating displacement in most cases. Meanwhile, coronal images showed similar effectiveness to axial images in detecting zygomatic bone fractures.

A comparison between clinical suspicion and CT identification of fractures highlights the superior accuracy of CT imaging in detecting maxillofacial fractures. Most significant discrepancies were observed in the posterolateral maxillary wall, where only 16 cases were clinically suspected compared to 32 detected on CT, and in the pterygoid plates, where no fractures were initially suspected but 11 were identified on CT. Similarly, fractures of the medial maxillary wall (12 suspected vs. 40 identified), orbital floor (6 suspected vs. 15 identified), and medial orbital wall (4 suspected vs. 24 identified) were notably underdiagnosed clinically.

In contrast, fractures of the anterior maxillary wall (24 suspected vs. 30 identified) and zygomatic arch (50 suspected vs. 54 identified) showed smaller discrepancies, indicating relatively better clinical detection in these regions.

Fractures of posterior frontal wall and pterygoid plates were entirely missed in clinical assessments but were clearly visualized on CT. Additionally, mandibular fractures were clinically suspected in 30 cases but confirmed in 37 cases through CT.

CONCLUSION

MDCT remains an essential diagnostic tool for evaluating maxillofacial injuries with high accuracy and reliability.

3D imaging plays a crucial role in detecting and assessing fractures, particularly in complex cases.

The study findings align with existing literature, emphasizing the importance of MDCT in trauma assessment.

A comparison between clinical suspicion and CT identification of fractures highlights the superior accuracy of CT imaging in detecting maxillofacial fractures.

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