The diagnostic value of Computed Tomography in evaluation of maxillofacial Trauma

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Abstract
A definite place has now been established for the computed tomography (CT) scanning in assessment and management of trauma victims. The diagnostic return of this sophisticated investigation was often far greater than could be expected or suspected from clinical examination and standardized radiology alone. The purpose of this study was to evaluate the role of CT examination in facial trauma.

Sample (78) patients of different sexes complaining from facial trauma were included in this study. CT scan showed (92) fractures in these patients in different sections. Coronal sections were used in (43) cases (46%) and the most common fracture was the zygomatic bone (32) case (34.7%).

The CT examination provide adequate radiographic assessment for facial bones like Orbit, midface and nasoethmoid region while it will not add more information than conventional imaging in mandibular area except the condyle area.

Introduction
The maxillofacial region is one of the most complex areas in the human body and the imaging of this region become even more difficult in traumatized patients because of their clinical condition and inability to cooperate. Conventional radiographs obtained in the maxillofacial injuries may be not easy to interpret, owing to the distortion and disruption of an already complex anatomical framework (1, 2).

Although there is a risk of radiation, computed tomography (CT) scan has the advantage of providing images of thin slices of the facial skeleton, overcoming the problem of the superimposition of structures that inevitably occurs on plain radiographs. Furthermore, the digital acquisition of information, as opposed to the analogue information of plain films, allows electronic manipulation of the data by altering the settings to provide images either at bony window levels or for optimal soft tissue evaluation. This increased contrast sensitivity also provides improved visualization of a wide variety of foreign bodies (3).

Advances in diagnostic techniques with computer technology and digital radiographic images offered the possibility for improvement of interpretation, adjustment and storage of the radiographic images using dedicated software programs. A definite place has now been established for the computed tomography (CT) scanning in assessment and management of trauma victims. The diagnostic return of this sophisticated investigation was often far greater than could be expected or suspected from clinical examination and standardized radiology alone (2), this view has been supported by other workers in this field. (4, 5, 6). Thus the purpose of this study was to assess the role of CT scan as a diagnostic tool in management of facial trauma in a sample of Iraqi patients.

Materials and Methods
During the period from March 2006 to March 2007, (46) patients from different sexes presented to the department of maxillofacial surgery, AL-Hilla Teaching Hospital with variety of facial injuries were included in this study. Another (32) patients from department of maxillofacial surgery, Teaching Hospital of Sulaimania also included in the study for the same purpose so the total number of the patients were (78) whose ages ranged from 19-58 years.
Criteria of Selection of the Patients

After initial assessment and clinical examination the following criteria were used to select the patients for CT scanning:

- No emergency treatment is needed according to the advance trauma life Support (ATLS).
- Patients with multiple facial injuries or severe facial disfigurement.
- Patients with craniofacial or cervical injuries.
- In cooperative patients or altered in the level of consciousness.
- Patients with trauma to upper third of the face or orbital injury.

CT Examination of the Facial Bones

The CT scan were arranged for all cases according to the injured area and the type of CT examination. The axial section was parallel to the orbitomeatal line while the coronal section was angled about 60-90 degree from the orbitomeatal line. A contiguous slices were performed through the traumatized area, (5mm) slice thickness were used in the regions of particular complex anatomical details or severely injured patients like nasoetmoid, orbital or LeFort fractures. Otherwise (5-10mm) sections were used for examination of mandibular or zygomatic fractures.

For combined craniofacial injuries (10mm) slice thickness was used for brain injuries and (5mm) section used for the facial bones.

All CT examination was reviewed on the monitor with magnification mode at multiple windows level this will modify the image for best diagnosis and differentiation between hard and soft tissues injuries.

Fig. (1): Axial CT show fracture of zygoma which displaced posteriorly.

Fig. (2): Coronal CT of condylar fracture.

Fig. (3): Coronal CT examination show orbital fractures of the floor and lateral
Results
In this study (78) patients suffering from facial trauma were included, the males were (52) patients (66.6%) while the females were (26) (33.4%). The age span was (19-58) years with mean age of (38) years. The number of facial bones fractures which detected by the CT examination were (92) fractures in different facial bones.

Types of the Facial Fractures
The fractured bones were classified according to anatomical involved region and the fracture of zygoma was the most common type of facial fractures in this study (32 fractures 34.7%) (Fig.1) followed by (21) mandibular fractures (22.6%) (Fig.2) as showed in Table (1).

Type of CT examination
According to traumatized region the CT examination was done by coronal scan in (43) different fractured area (46%) followed by axial section in (28) region (32%) and both examinations were done in (21) area (22.6). Table (2)

Types of Fractures According to the Area
According to area involved Table (3), the results showed the tripod fracture of zygoma was the most common which detected in (12) cases while the LeFort II fractures were detected in (8) cases followed by fractures of the floor of the orbit in (6) cases (Fig.3).

<table>
<thead>
<tr>
<th>Site</th>
<th>Zygoma</th>
<th>Mandible</th>
<th>Mid face</th>
<th>Orbit</th>
<th>Nasoethmoid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>32(34.2%)</td>
<td>21(22.6%)</td>
<td>20(21.5%)</td>
<td>13(14.1%)</td>
<td>6 (6.1%)</td>
<td>92(100%)</td>
</tr>
</tbody>
</table>

Table (1) : Distribution of facial bones fractures detected by CT examination

<table>
<thead>
<tr>
<th>Site</th>
<th>Axial CT</th>
<th>Coronal CT</th>
<th>Both Sections</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Zygoma</td>
<td>12</td>
<td>14</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>Mandible</td>
<td>7</td>
<td>9</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Mid face</td>
<td>5</td>
<td>11</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Orbit</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Nasoethmoid</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>43</td>
<td>21</td>
<td>92</td>
</tr>
</tbody>
</table>

Table (2) : Type of CT examination
Discussion
The CT scanner has revolutionized radiology and it is probably the most important development in diagnostic medicine since Roentgen’s discovery of X-ray in 1895. (4) The use of offers several advantages such as early diagnosis when the facial edema, sever laceration and altered consciousness may limit a good clinical examination and affect the treatment plan.

It was founded in this study that (5mm) slice thickness is sufficient for CT imaging of a patient with facial trauma even in sever trauma or imaging of complex anatomical area like the orbit, nasoethmoid or maxillary bones. These results were disagree with other researcher who recommended a thin slices (2-3mm)(7,8) , therefore this will decrease the time of scanning and the risk of radiation.

Another advantage of this examination was providing accurate information about the combined injuries of both hard and soft tissues which cannot be done by any other imaging modalities.

Zygomatic and Orbital Fractures
The diagnosis of orbital and zygomatic fractures is often difficult due to accompanying edema, ecchymosis, limitation of ocular movement and association with other injuries (9). The amount of mediolateral displacement of the zygoma with Axial rotation in zygomaticomaxillary complex fractures, as well as the lateral wall of the maxillary sinus, floor of the orbit and lateral orbital wall was easily demonstrated by CT examination especially coronal section.

Blow out fractures of both orbital floor and medial wall, together with their relation to the soft tissues escape or entrapment were particularly well shown by coronal CT. Therefore CT considered to be the best single investigation for orbital injuries as it show the bony wall and soft tissues content of the orbit like globe, optic nerve and extraocular muscles in addition of volumetric changes of the orbital compartment (Fig.3) . These properties make CT examination very useful in detection of even small foreign bodies (Fig.4).

Mid face and Nasoethmoidal Injuries
Fractures of the mid face are some times difficult to identify on conventional radiograph because of thin bones lie in different planes and may be superimposed on each other (10). In this study the LeFort fractures are examined by both axial and coronal sections and we founded that pure isolated form of LeFort fracture is not always seen and most

<table>
<thead>
<tr>
<th>Site</th>
<th>Involved area</th>
<th>Tripod</th>
<th>Arch</th>
<th>Comminuted</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zygoma</td>
<td>Non displaced</td>
<td>9</td>
<td>12</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>mandible</td>
<td>Angle</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Midface</td>
<td>LeFort I</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Orbit</td>
<td>Floor</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table (3) : Types of the fractures according to the involved area
mid face fractures were combination of different types of facial fractures and this agree with other CT scan studies . (11,12)

The second observation is the general orientation of LeFort lines of facial fractures were horizontal so the coronal CT lie perpendicular to these lines make it more informative and accurate in diagnosis of these fractures (Fig. 5).

CT examination provide a definitive imaging modalities of patients with nasoethmoidal injuries in both axial and coronal sections , it show the orbital rims, nasal complex, and paranasal sinuses also cerebrospinal fluid leakage due to cribriform plate fracture can be detected.

**Mandibular Fractures**

In this study the examination of mandibular fractures by CT scan add no information than these obtained by conventional radiography so its un useful to used the CT in this part of the face ,but CT can be requested specifically for the intra capsular condyle fracture.

**Combined Head and Maxillofacial Injuries**

In those patients with combined injuries CT examination of the head and the face can be done at the same time. The examination of the face will not increase the scanning time (about one minute) because the mid face area can be examined by (10-15) sections and this will cover the nasoethmoid, orbit, and mid face. The diagnostic value of this evaluation provides useful information for treatment planning for both maxillofacial surgeon and neurosurgeon.

The evaluation of facial trauma by coronal section was superior than axial one this enable the examiner to assess the facial bones with fewer sections and less radiation specially for orbital and mid face fractures .But the coronoal section has two major disadvantages which is the position of the patients and the artifacts (specially dental restorations) that obscure details , these disadvantages dose not to be a significant limitation of CT examination and can be avoided by use tilting gantry and identification of metal restorations by scout view.

**References**


