

The Use of Spiral Computerized Tomography in the Diagnosis of Middle –Third Facial Fractures as Compared to Plain Radiography

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ABSTRACT

Background: Trauma is one of the most common clinical problems that confront the maxillofacial surgeon and radiologist alike. Middle third facial fractures are diagnosed primarily on the bases of clinical examination and plain radiographs than can result in much preoperative speculation.

Objective: To assess the advantages of spiral computerized tomography over conventional radiography in the pre-surgical evaluation of middle third facial fractures.

Methods: Thirty patients with thirty-eight facial fractures were studied, all patients were examined clinically, by plain radiography and then by spiral CT.

Results: Of the 38 middle-third fractures, 16 (42.1%) were zygomatic fractures, 8 (21.1%) were LeFort fractures, 6 (15.8%) were residual deformities, 4 (10.5%) were orbital blow-out fractures and 4 (10.5%) were naso-ethmoidal injuries.

Conclusion: Improved diagnosis of fracture lines, specific patterns of comminution in mid-face fractures, direction of displacement of fracture fragments and the associated soft tissue changes made possible with spiral CT.

Keywords: Trauma, middle third facial fractures, spiral CT.

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Introduction

The facial skeleton can be roughly divided into three areas: the lower third or mandible, the upper third, an area extending downwards from the frontal bone to the level of the upper teeth or, if the patient is edentulous, the upper alveolus.

Fractures of the middle third of the facial skeleton and/or the mandible are known as "maxillofacial injuries" and they are associated with varying degree of involvement of the overlying soft tissues and such neighboring structures as the eyes, nasal airways, paranasal sinuses and tongue. The bones of the middle third of the facial skeleton present a superficial appearance of strength but they are, in fact, comparatively fragile and they fragment and comminute easily. In view of the fact that they articulate and interdigitate in a most complex fashion, it is difficult to fracture one bone without disrupting its neighbors.⁽¹⁾

For the majority of facial injuries, especially the most encountered injuries involving the mandible, dentoalveolar components of the jaws and nasal areas, plain radiography will suffice.

Conventional radiographs obtained in mid-face injuries are seldom easy to interpret, owing to the distortion of an already complex anatomical bony framework. Those bones forming the orbits, ethmoidal air cells; paranasal sinuses and mid-face are relatively thin and they lie within different planes with considerable variation of

their radiodensity. The resultant picture obtained on plain radiographic views is a confusion of superimposed images. This is never more so than when distorted or disrupted by trauma.⁽²⁾

Recently spiral CT has been used to study a variety of maxillofacial disorders. There have been several reports describing the use of spiral CT for diagnosing facial bone injuries^(3,4).

Methods

Thirty patients had been evaluated in this prospective study in a period from February 2001 to November 2002. Those were suffering from middle third facial injuries, 25 patients were males and five were females, and their age range was between 14-58 years, isolated nasal fracture and isolated maxillary denotoalveolar fracture were not included in this study.

For patients in causality department, primary assessment and resuscitation were done with suturing of soft tissue injuries, when their general condition became stable; they were referred to radiology department for plain x-ray(s) of skull and facial skeleton and other parts of body according to suspected fracture(s).

Clinical examination commences with an inspection and palpation of each area of mid face (orbit, nose, malar eminence) followed by intra-oral examination (sulci, teeth occlusion, tongue). Plain radio graphical examination carried with occipito-mental (OM) projection for all patients,

additional projection(s) according to suspected

fracture(s). Basically, all CT images taken in axial plane coronal, sagittal, SSD reconstruction. The CT examination carried out in the unit of spiral CT scan in the Al-Kadhmia teaching hospital by one senior radiologist with the following CT examination factors:

140KV, 120mA, slice thickness 2mm, one second slice time, soft tissue window width 250, window level 40, bone window width 2000 and bone window level 500.

Results

Out of 34 patients, twenty-five patients were male constituting 83.3% while only 5 patients were female constituting 16.7% the youngest patient was 14 years old while the oldest one was 58 years old, and the mean age was 36 years old. The causes of fractures were divided into six groups as shown in **Table -1**.

In our study, the total number of mid-face fractures was 38 fractures, **Table-2**.

All patients have plain radiographs of their mid-face fractures and other suspected fractures.

The results of plain film examination were divided into two groups:

- 1- Cases with plain radio graphical evidence of fracture with direct sign (defect in cortical out line) and indirect sign (clouding of sinuses, soft tissue swelling and soft tissue emphysema).
- 2- Cases with no plain radio graphical evidence of fracture, **Table-3**.

Spiral CT examination was able to demonstrate, the course of fracture lines, the areas of comminution, the direction of displacement of fracture fragments, the soft tissue elements; the internal architecture of the orbits and sinuses also demonstrated the normal and the pathological anatomy of these regions clearly, **Table-4,5**.

Discussion

All of our cases with LeFort fractures have plain radio graphical evidence of fracture (some of these evidences are not specific for LeFort fractures), therefore fractures of the maxilla are best documented by CT scan examination, this opinion coincides with Manson (1990) who stated that fractures of the maxilla are best documented by careful CT scans.⁽⁵⁾

In one of sixteen cases (6.2%), there were obvious clinical signs of zygomatic fracture but radio graphical examinations could not verify the diagnosis (the fracture was confirmed by spiral CT examination), this closely corresponds to the study of Jungell and Lindquist⁽⁶⁾.

The diagnosis of blow-out fracture is frequently missed if the radio graphical examination does

not include a CT scan⁽⁵⁾ which corresponds to our findings in that in one case of blow-out fracture there was no plain radio graphical evidence of fracture. Fracture lines on plain films may be mistaken for superimposed bony septa or suture lines, or may be hidden by disease processes in the underlying maxillary sinus. The thin orbital floor, partially transparent on radiographs, may be obscured against the background of other bones of the skull⁽⁵⁾.

Two cases with residual deformities had no plain radio graphical evidence of previous fractures.

One case (16.6%) had enophthalmos (the most popular theories of the mechanism of enophthalmos are bony orbital enlargement and fat atrophy), this agrees with Manson *et al*⁽⁷⁾ wherein before CT volume analysis, no reliable measurement of the degree of bony and soft tissue deformity was available. One case (16.6%) had persistent diplopia, thought to result from scar contracture or adhesion either within ocular muscles or between them and other structures.

Naso-ethmoidal fractures produce medial orbital wall displacement, difficult to see on plain films, can sometimes be seen on occipito-frontal and occipito-mental views. The lateral view shows fracture of the orbital roof, but superimposition of the thick lateral frontal bone and medial anterior cranial fossa may make this diagnosis difficult. Fractures of anterior and posterior tables of frontal sinus can be seen on lateral head view, especially if segments are displaced. An air-fluid level in the sinus, and pneumocephalus if the posterior table is disrupted, may be seen⁽⁸⁾.

One case (25%) with Naso ethmoidal fractures have no plain radio graphical evidence of fracture (the fracture confirmed by spiral CT examination), this is coincide with Johnson *et al* (1984)⁽⁹⁾ who noted that many fractures in this area were undetectable on plain radiographs.

Spiral CT is the procedure of choice after plain films where more sophisticated imaging is desired. CT provides an improved method for the evaluation of the osseous and soft tissue structures, useful in the assessment of mid-face trauma by providing information that can't be obtained by conventional radiographs.

The use of spiral CT in mid-face trauma offers several advantages: earlier diagnosis is possible when facial edema, laceration and altered consciousness limit clinical examination, course of fracture lines, areas and degree of comminution, direction of displacement of major fracture fragments and multiple fractures, all are better seen there is also ability to demonstrate soft-tissue changes associated with bony injuries.

Table (1): Distribution of the Patients According to Etiology of Trauma

Type of Fracture	no. of Fractures	%
Zygoma	16	42.1%
LeFort	8	21.1%
Residual Deformities	6	15.8%
Blow – Out	4	10.5%
Nasoethmoidal	4	10.5%
Total	38	100%

Table (2): Distribution of the Fractures According to the Type

Etiology	no. of Patients	%
Road traffic accidents	18	60 %
Assault	4	13.34%
Missile injuries	3	10%
Fall from height	3	10%
Sport injuries	1	3.33%
Industrial injuries	1	3.33%
Total	30	100%

Table (3): Plain Radiographic Findings

Number and Percentage of Fractures						
Type of Fracture Findings	LeFort I	LeFort II	Zygoma	Blow –Out	NE*	Residual Deformity
Evidence of Fracture	1 (100%)	7 (100%)	15(93.7%)	3 (75%)	3 (75%)	4 (66.7%)
No evidence of Fracture	0	0	1 (6.25%)	1 (25%)	1 (25%)	2 (33.3%)
Total	1 (100%)	7 (100%)	16 (100%)	4 (100%)	4 (100%)	6 (100%)

Table (4) Spiral CT Findings (Bone)

Number of Fractures						
Type of fracture Fracture Surface	LeFort I	LeFort II	Zygoma	Blow –out	NE*	Residual Deformity
1-Anterior maxillary wall	1	7	11	2	3	1
2- Lateral maxillary wall	1	7	8	2	2	1
3- Medial maxillary wall	1	5	2	2	2	-
4- Orbital floor	-	3	13	3	1	3
5- Inferior orbital rim	-	5	13	3	1	2
6- Lateral orbital wall	-	3	13	-	-	4
7- Medial orbital wall	-	1	1	3	4	-
8- Zygomatic body	-	3	4	-	-	5
9- Zygomatic arch	-	1	3	-	-	1
10- Pterygoid plate	1	4	2	-	-	1
11- Cribriform plate	-	2	1	-	1	1
12- Frontal process of maxilla	-	2	-	1	4	-

*N.E = Nasoethmoid.

Table (5): Spiral CT Findings (soft tissue).

Type of Fracture Findings	Number of Fractures					Residual Deformity
	LeFort I	LeFort II	Zygoma	Blow –Out	NE*	
Soft Tissue Density in Sinuses**	1	7	13	4	4	3
Extra–Ocular Muscle Entrapment	-	1	3	2	1	1
Enophthalmos	-	3	4	2	1	2

* N.E = Nasoethmoid.

** Soft tissue density includes blood, fat and muscle.

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