Diagnostic Accuracy of 3d Scan and Plain Radiograph in Diagnosis of Midface Fractures

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Abstract

OBJECTIVE: To determine the diagnostic accuracy of plain radiographs and 3D scan in diagnosis of mid face fractures by taking surgery findings as a gold standard. **STUDY DESIGN**: Cross Sectional Study **SETTING:** study was carried out at Department of Oral & Maxillofacial Surgery, Nishtar Institute of Dentistry, Multan. **DURATION**: Study was completed in 6 months from May, 2017 to November 2017in Nishtar . **Methodology:** 181 Patients were included from Department of Oral & Maxillofacial Surgery, Nishtar Institute of Dentistry, Multan after taking informed consent and permission from ethical committee and research department. Demographic information of patients (name, age, gender, duration of Fracture had taken. Patients from both gender with age range of 18-35 years having Maxillofacial trauma < 10 days were included in this study and patients in which CT scan was contraindicated and those taken any surgical treatment for facial trauma were excluded in this study. Radiographic examination for the cranio-facial complex had performed for all patients followed by routinely and according to the needs of each individual case. **RESULTS:** From 181 patients, the minimum age was 18 years and maximum age was 35 years. According to plain radiographs, fracture was detected in 88.4% patients. By using 3D scan, fracture was detected in 96.7% patients. Sensitivity of 3D scan for detection of fracture was calculated as 98.13%, specificity was 14.28%, positive predicted value was 89.71%, negative predicted value was 50% and diagnostic accuracy was 88.39%. **CONCLUSION:** Among 181 patients, fracture was detected in 88.4% patients by using plain radiographs. By using 3D scan, fracture was detected in 96.7% patients. Sensitivity of 3D scan for detection of fracture was calculated as 98.13%, specificity was 14.28%, positive predicted value was 89.71%, and diagnostic accuracy was 88.39%.

Keywords: 3D scan, plain radiographs, mid face fractures
DOI: 10.7176/JMPB/60-01
Publication date:October 31st 2019

INTRODUCTION

Most commonly mid face fractures occur because of motor vehicle accidents, falls, assaults and blunt traumas. (1,2) Computed tomography(CT) is now a standard imaging technique for the evaluation of injuries to determine which patients require surgical intervention. (3,4)

For the planning of the restoration of facial skeleton, surgeon's need thorough understanding of degree and nature of facial skeleton damage. .Minor, even clinically irrelevant fractures of the facial skeleton can be visualized by CT scan.(5) For the patients with blunt facial trauma to detect both soft tissue and osseous defects including even hairline which often get diagnosed in routine examination, high resolution computed tomography with 3D reconstruction has been increasingly in practice.(6) In past, conventional Palin film radiographs were mostly used for the evaluation of facial injuries. Different radiographs can be used according toh the suspected type of injury. These may include lateral, Caldwell projections and occipitomental view. (7) Conventional radiographs are sensitive to cranial vault fractures not to fractures of skull base and facial skeleton. (8,9)

Conventional X-ray is no longer the standard in radiological imaging for cranio-facial trauma detection. CT is widely available and allows fast scanning of the patient.(10) CT scan enables a precise diagnosis of all kind of fractures of the facial skeleton and skull base, and it also provides essential information about intracranial bleeding and injuries to the cerebrum.(8,9) CT scan can help in better understanding some of the more complex facial fractures and can also aid in planning surgery when reconstruction is necessary.(7)

The rationale of this study is to determine the diagnostic accuracy of plain radiographs and CT scan in diagnosis of mid face fractures so that precise treatment can be done.

METHODOLOGY

Total 181 Patients were included from Department of Oral & Maxillofacial Surgery, Nishtar Institute of Dentistry, Multan after taking informed consent and permission from ethical committee and research department. Demographic information of patients (name, age, gender, duration of Fracture had taken. Patients from both gender with age range of 18-35 years having Maxillofacial trauma < 10 days were included in this study and patients in which CT scan was contraindicated and those taken any surgical treatment for facial trauma were excluded in this study. Radiographic examination for the cranio-facial complex had performed for all patients followed by routinely and according to the needs of each individual case. The extra-oral projections included

submento-vertex, reverse Town's, Postero-anterior, Water's view, Orthopantamogram, panoramic, transpharyngeal, lateral oblique and true lateral views had followed by non-contrast CT scan of the face. The CT examination had performed on the Siemens Somatom Balance (spiral rotating system) at settings of 130 kVp, 90 mA and scan time of 20s. 3D facial reconstruction CT unit had used and the slice thickness had used in this study ranges from 2mm to 6mm. continuous volume scan had taken in axial, coronal and saggital plane, which makes an image of three dimension or a 3D reconstruction.

All patients had then sent for surgical treatment. Data had collected regarding diagnosis of mid face fractures by plain radiographs and CT scan. Data had recorded on especially designed proforma.Data analysis had performed by using SPSS-23 software. Data for age and duration of fracture had described by using Mean±SD and for age groups and gender by frequency and percentages. Sensitivity, specificity, Positive predicted value, Negative predictive value and diagnostic accuracy for plain radiographs and 3D scan against surgery findings had calculated by using 2X2 table. Effect modifiers like age, gender and duration of fracture had controlled by stratification. Post stratification sensitivity, specificity, positive predicted value, negative predictive value and diagnostic accuracy had calculated.

RESULTS

From 182 patients, it was observed that the minimum age was 18 years and maximum age was 35 years with mean ± standard deviation as 26.43 ± 4.66 years. The minimum duration of fracture was 1 day and maximum was 9 days with mean ± standard deviation as 3.15 ± 2.61 days (Table 1). There were 108 (59.7%) male patients and 73 (40.3%) female patients (Table 2). According to plain radiographs, fracture was detected in 160 (88.4%) patients while it was not detected in 21 (11.6%) patients (Table 3). By using 3D CT scan, fracture was detected in 175 (96.7%) patients while it was not detected in 6 (3.3%) patients (Table 4). Sensitivity of 3D scan for detection of fracture was calculated as 98.13%, specificity was 14.28%, POSITIVE predicted value was 89.71%, negative predicted value was 50% and diagnostic accuracy was 88.39%. By stratification of age, the diagnostic accuracy of < 26 years age group was 93.68% and the diagnostic accuracy of ≥ 26 years age group was 83.72%. The diagnostic accuracy was found as 87.96% in males while in females it was 89.04%. By stratification of age, the diagnostic accuracy of < 5 days was 88.55% and the diagnostic accuracy of ≥ 5 days was 86.0%.

Table:1 Descriptive Statistics n=181

	Minimum	Maximum	Mean	Std. Deviation
Age (years)	18	35	26.43	4.66
Duration of fracture(days)	1	9	3.15	2.61

Table2: Distribution of Gender(n = 181)

Gender	Frequency	Percentage
Male	108	59.7%
Female	73	40.3%
Total	181	100%

Table 3. Distribution of plain radiographs accuracy(n = 181)

Plain radiographs accuracy	Frequency	Percentage
Positive	160	88.4%
Negative	21	11.6%
Total	**181**	**100**

Table 4. Distribution of 3D scan accuracy (n = 181)

3D scan	Frequency	Percentage
Positive	175	96.7%
Negative	6	3.3%
Total	**181**	**100**

DISCUSSION

In previous studies,3D-CT reconstructed images enabled the radiologist to improve the visualization and to manipulate volumetric data readily, to establish an accurate application to maxillofacial region.[11,12] 3D-CT scan reproduces the osseous structures, providing complete inspection of the reproduced structure from any viewpoint (including internal inspection), better understanding of anatomy. It also aids the evaluation of the operative results for craniofacial surgery. (13) Rhea, et al.[14] (1999) and Carls, et al.[15] (1994) also observed that 3D images provided an easy detection of specific characteristics of facial asymmetries, midface defects and skull vault defects and alsofractures which are associated with extensive bone displacement are better localized by using 3D imaging technique.

Ohkawa, et al.[16] (1997) reported that both 2D-CT and 3D CT techniques presented a similar sensitivity for the diagnosis of fractures in the mandibular region, though 3D-CT imaging allowed a better visualization of the fractured site.In another study, it was found [17] that the facial radiograph for detection of fracture has the sensitivity of 90%, the specificity of 94.7%, and the accuracy of 91% (17).But in our study accuracy was 88%. Although facial radiography was associated with a high diagnostic rate,but its ability to visualize the complex facial fractures such as fractures at the nasal bone, maxillary sinus, mandible bones and the orbital rim is still limited.[18-20] However many studies show that the result of facial CT scan is superior to that of facial radiographs for the accurate diagnosis of the facial skeleton.[21].

CONCLUSION:

Among 181 patients, fracture was detected in 88.4% patients by using plain radiographs and by using 3D scan, fracture was detected in 96.7% Sensitivity of 3D scan for detection of fracture was calculated as 98.13% and diagnostic accuracy was 88.39%.The results showed 3D scan is superior to the conventional facial radiographs.

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