Assessment of utility of cone beam computed tomography in maxillofacial trauma: A retrospective study

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Abstract

Introduction and Aim: CT/CBCT data from maxillofacial trauma patients can provide 3D reformatted images that give the trauma surgeon a unique perspective of the nature of the injury and the degree of displacement of the fracture segments, which helps guide the appropriate surgical approaches for the fracture reduction and stabilization. Hence the present study was planned to assess the utility of CBCT imaging in various maxillofacial trauma.

Materials and Methods: The present retrospective study was planned and conducted on the CBCT evaluation of 40 patients that all presented with fractures due to craniofacial trauma over a period of two years. All the imaging scans were performed with the diagnostic purpose. There was use of Promax 3d (Planmeca, Finland), it is characterised by the exposure time of 18 seconds.

Results: For the age group of 22 years to 30 years there were mandibular condyle fracture and mandibular angle fracture, for the age group 31 years to 50 years there were mandibular angle fracture, nazal bone fracture, mandibular condyle fracture and zygomatic fracture, for the age group of 51 years to 60 years zygomatic fractures.

Conclusion: CBCT is most frequently applied in oral and maxillofacial surgery, endodontics, implant dentistry and orthodontics. CBC can be a quick and useful method used in diagnosis and therapeutic planning of craniofacial trauma. This technique can be successfully applied in cases of mild craniofacial fractures and cracks and can help us to reduce the dose of radiation, costs and time required to achieve examinations.

Keywords: Assessment, CBCT, Maxillofacial Trauma, Utility.

Introduction

The introduction of cone-beam computed tomography (CBCT) specifically dedicated to imaging the maxillofacial region heralds a true paradigm shift from 2D to 3D approach to data acquisition and image reconstruction.(1) Interest in CBCT from all fields of dentistry is unprecedented because it has created a revolution in maxillofacial imaging, facilitating the transition of dental diagnosis from 2D to 3D images and expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures by way of third-party applications software.(2)

Computer tomography volume is a modern alternative to conventional imaging diagnostic methods such as X-rays of the skull and computer tomography, which is characterized by high-resolution, making narrow sections of 0.125 mm and viewing anatomic structures in the three planes: axial, coronal and sagittal. CBCT is used as an imaging technique in oro-maxillo-facial surgery. The three-dimensional reconstruction provides relevant information for diagnosis in maxillofacial trauma and anatomic variations and abnomalies.(3,4)

With the development of three dimension technique even smaller changes in the tissue density differential can be identified. Although the field of radiology has long played an exciting and critical role in dentistry, maxillofacial imaging has added a third dimension to the effective diagnosis and management of patients with facial bone fractures.(4,5)

Cone beam computed tomography has gained a broad acceptance in dentistry in the last 5 years although its root goes back about 2 decades. The major innovation in cone beam imaging compared with intraoral and panoramic imaging is that it provides high quality, thin slice images. CBCT equipment is smaller, compact and less expensive than traditional CT. These machines emit x-ray shaped like a cone so that the beam covers the entire region of interest. They are most appropriate for examining individual teeth for fracture, pre and post operative assessment of craniofacial fractures.(6,7)

CT/CBCT data from maxillofacial trauma patients can provide 3D reformatted images that give the trauma surgeon a unique perspective of the nature of the injury and the degree of displacement of the fracture segments, which helps guide the appropriate surgical approaches for the fracture reduction and stabilization.(8) Stereolithographic models can also be made that provide the surgeon with 3D models that can be used for further diagnosis and creation of custom implants and/or plates. In delayed trauma reconstruction, it can be difficult to create symmetry with the uninjured side, making custom plates invaluable.(9)

Thus, CBCT combines the strength of medical CT with those of conventional dental radiography to

accommodate unique diagnostic and treatment planning applications. Hence the present study was planned to assess the utility of CBCT imaging in various maxillofacial trauma.

Materials and Methods

The present retrospective study was planned and conducted on the CBCT evaluation of 40 patients that all presented with fractures due to craniofacial trauma over a period of two years. All the imaging scans were performed with the diagnostic purpose. There was use of Promax 3d (Planmeca, Finland), it is characterised by the exposure time of 18 seconds.

Explores were made using and following the CBCT protocol. Techniques and various parameters were selected differently owing to the different characteristics and requirement, age and body structure of the patients. All dicom films generated by CBCT investigations were visualised using software Romexis. The data obtained were processed using two programms dedicated to medical statistical analysis – SPSS 19.0 for microspft excel.

Results

The patients included in the study were of the age range between 22 years to 60 years. Out of the total included 40 patients 14 were female and 26 were male. All the patients were provisional diagnosed with maxillofacial trauma and were subjected to CBCT analysis. Malar bone fracture was found in 16 patients, nasal bone fracture was found in 9 patients, mandible was fractured in 4 patients, maxilla was fractures in 5 patients and orbital fracture was found in 7.

The frequency of mandibular fractures by location: 2 in condyle, 1 in angle of jaw and 1 in body of mandible. For the age group of 22 years to 30 years there were mandibular condyle fracture and mandibular angle fracture, for the age group 31 years to 50 years there were mandibular angle fracture, nazal bone fracture, mandibular condyle fracture and zygomatic fracture, for the age group of 51 years to 60 years zygomatic fractures.

The frequency of fracture by type is as follows. (Table 1)

Table 1: Frequency of fracture according to their type

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Linear course of fracture without displacement	25	62.2	62.2	63
Linear course of fracture with displacement	9	21.4	21.4	82
Comminuted	6	16.4	16.4	100
Total	40	100.0	100.0	

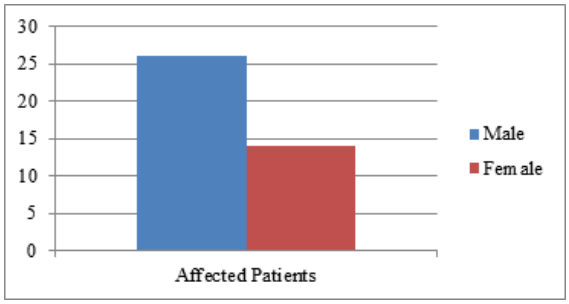

Fig. 1: Sex distribution of the patients included in the study.

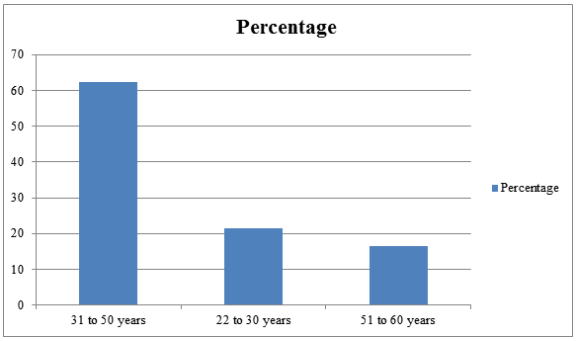

Fig. 2: Distribution of patient according to age

Discussion

CBCT combines the strength of medical CT with those of conventional dental radiography to accommodate unique diagnostic and treatment planning applications. Recently, ultrasound has been introduced as an alternative diagnostic modality in maxillofacial traumatology and traditionally used in diagnosing orbital and mid-facial injuries especially for visualizing Zygomatic arch fracture and Nasal bone fractures.[10,11]

CBCT technology has been extensively used in clinical dental practice with the following advantages in maxillofacial imaging:[6] CBCT being smaller equipment, has a significantly reduced physical footprint and is approximately one quarter to one-fifth the cost of conventional CT. Higher resolution and diagnostic potential. Rapid scan time between 10 and 40 seconds. Collimation of the CBCT primary x-ray beam enables restraint x-radiation to the area of interest. Images with submillimeter isotropic voxel resolution ranging from 0.076- 0.4 mm, their depth is usually in the order of 1−2 mm.8 Reduced patient radiation dose equivalent to 5 to 74 times that of a single film-based panoramic X-ray. Reconstructs the projection data in three orthogonal planes (axial,

sagittal, and coronal). Reduced image artifact when compared to conventional CT.

One of the most clinically useful aspects of CBCT imaging is the highly sophisticated software that allows the huge volume of data collected to be broken down, processed or reconstructed. This makes data interpretation much more user friendly, if the appropriate technical and educational knowledge is available.[12]

The literature on CBCT is promising and needs further research, especially with regard to its use in forensic dentistry, in order to explore more potentially beneficial indications in that area. No literature concerning direct CBCT indications in prosthodontics was found.[12,13] However, several overlapping indications were found in other dental specialties attributing to the final standard of care in prosthodontic treatment. These indications include but are not limited to bone grafting, soft-tissue grafting, prosthetically driven implant placement, maxillofacial prosthodontics and temporomandibular joint disorder. CBCT images can also be of great value in special cases in which multiple teeth have to be assessed for restorability.[13,14]

Although numerous studies have used and are still using classical computer tomography, Cone Beam Computed Tomography (CBCT) is gaining ground in assessing patients with mild craniofacial trauma. This is due to reduced cone beam X-ray machine size, dose of radiation, time required for scanning and discounted cost. According CBCT technology, radiologists can provide a full and accurate diagnosis that can lead to an appropriate surgical planning.

Conclusion

CBCT is most frequently applied in oral and maxillofacial surgery, endodontics, implant dentistry and orthodontics. CBCT examination must not be carried out unless its medical necessity is proven and the benefits outweigh the risks. CBC can be a quick and useful method used in diagnosis and therapeutic planning of craniofacial trauma. This technique can be successfully applied in cases of mild craniofacial fractures and cracks and can help us to reduce the dose of radiation, costs and time required to achieve examinations.

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