ORIGINAL RESEARCH

The usefulness of CBCT in the Assessment of Maxillofacial Pathologies

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ABSTRACT

Introduction: Radio-diagnosis plays an important role in the dental practice management process, so there is a need to have an advanced diagnostic modality to detect the pathology at an early stage and provide the best possible treatment to the patient.

Method: In order to provide the best possible therapeutic outcome, we discussed 222 cases of maxillofacial pathologies that were identified using cone beam computed tomography (CBCT).

Aim: To determine if CBCT is a valuable imaging modality for diagnosing patients with maxillofacial pathology.

Result: CBCT scans revealed pathologies such as radicular cysts, residual cysts, dentigerous cysts, maxillary sinusitis, odontogenic keratocysts, Langerhans cell histiocytosis, Osteomyelitis, Fibro-osseous lesions, Stafne bone cyst, fractures, Ameloblastomas, Sialoliths, Aneurysmal bone cyst, TMDs and maxillofacial malignancies.

Conclusion: CBCT proved to be very essential in assessing various radiological changes in patients with maxillofacial pathologies, thereby improving patient care and ensuring low morbidity associated with resection.

Keywords: Cone-Beam Computed Tomography, advanced therapeutic diagnosis, maxillofacial pathologies.

INTRODUCTION

CBCT raised up as an interesting alternative with lower radiation dose and easy set up being one of the major advantages it has been a remarkable development in the field of dentistry or dental radiology. It has allowed clinicians to view dental anatomy and pathologies with greater ease. This study was undertaken to evaluate the accuracy of CBCT in diagnosing the patients with maxillofacial pathologies for their better therapeutic outcome.

AIMS AND OBJECTIVES

To assess the location, nature and extent of various pathologies affecting the maxillofacial region. To assess the cyst-like lesions of the jaw, evaluate their true nature, location, size, extent and effect on the surrounding structures by CBCT. To assess the various neoplasms of jaws and evaluate their true nature, location, size, extent and effect on the surrounding structures by CBCT. To assess and evaluate the traumatic injuries of the maxillofacial complex.

MATERIALS AND METHODS

Total no. of 222 patients of both genders were referred to radio diagnosis wing for cone beam computed tomography scan of the upper jaw and lower jaw as a suspected case of some disease/ pathology, was selected for this study.

Patients were planned for CBCT scan taken with New Tom Giano CBCT unit operating at 10mA, 76kVp with voxel size of 0.1x0.1x0.1(mm). Field of view (FOV) was adjusted at 11x8 cm 11x5 cm 5x5 cm 8x5 cm and 5x5 cm according to the site which was involved and with accessory attachments (like a computer) and other facilities. Newtom new technology (NNT) software was used for this study.

CBCT scans were recorded in all three planes i.e.

coronal, axial, sagittal, also multiplanar reformation (MPR) was reconstructed. Thickness of image slides was 0.3mm for sagittal, axial and coronal section and 3D images and were assessed for different features like location, number, altered bony architectural pattern, extension of invasion, involvement of nerve canal and foramen alterations with effect on dentition.

STATISTICALANALYSIS

The results were then tabulated and were subjected to statistical analysis.

RESULTS

In our study, the maximum number of patients were 222 in which males were 149 (67%) and females were 73 (33%). Maximum patients were in the age group 21-30 years (26) and the minimum in the age group 8-18 years (Table 1) while the gender distribution of various cystic lesions showed total 21 cases of radicular cyst, (males; 10, females; 11) 12 cases of dentigerous cyst, (males; 10, females; 2) 6 cases of odontogenic keratocysts (males; 3, females; 3) 1 case of aneurysmal bone cyst (males; 1, females; 0) 3 cases of residual cyst (males; 2, females; 1) and 1 stafnes bone cyst (males; 1, females; 0) (Table 2) Based on the location radicular cyst was seen in maxillary anterior region, dentigerous cyst in right mandibular posterior region, odontogenic keratocyst in right and left mandibular posterior region, aneurysmal bone cyst in maxillary anterior region, residual cyst in mandibular right posterior region , stafne's bone cyst in mandibular left posterior region. Expansion of bone was seen in radicular and odontogenic keratocyst, effect on surrounding structure with breach was appreciated in cases of radicular cyst, odontogenic cyst and aneurysmal bone cyst.(Table 4) Maximum number of patients showed right side maxillary sinus opacification. Fibro osseous lesions were present in left posterior mandibular lesion. Sialoliths in right submandibular region, in maximum number of patients malignancies were involved in the bilateral mandibular posterior region. Temporomandibular joints changes were equal sided affected in most of the patients. Maxillary fractures involving zygomatic arch was present in maximum number of patients.(Table 3) Mucormycosis in maxillary region while osteomyelitis was present with equal percentage in maxilla and mandible. (Table 7)

DISCUSSION

With the advent of CBCT in the field of maxillofacial imaging, this has proved a innovative method of three dimensional evaluation for the diagnosis of various pathologies of the maxillofacial region. Although it is easy to spot disorders clinically because of their characteristic clinical features, signs, and symptoms in the majority of the cases.[1]

But the presence, extent and pattern of invasion in bone and involvement of intraosseous vital structures are needed to be evaluated for the treatment planning and prediction prognosis.

The therapy of these patients with oral cavity disorders has undergone a revolution in recent years because of the introduction of 3-D information in dental-maxillofacial imaging. Cone-beam CT (CBCT), a new tool in dental radiography that uses a cone-shaped X-ray beam to obtain a three-dimensional image in a single scan, has made it possible to analyze and assess the various bone invasions brought on by disorders like oral carcinomas, cystic lesions, or fibro-osseous lesions also fungal infections.[2]

When assessing cystic lesions, in this present study, with the use of thisadvanced tool, we evaluated most of the cystic lesions were better located and was helpful in determining the extension and location. CBCT gave the most details for the detection of root canal morphology and periapical lesions, while intraoral periapical radiograph outperformed oral pantamogram (CBCT > IOPAR > OPG). The results in this study were consistent with findings from earlier research using CBCT to determine the lesions extension and involvement of vital structures.[3]

Similar findings have been noted in earlier studies, namely that during preoperative diagnostic and postoperative tests, CBCT revealed more apical lesions than periapical images. The presence of periapical radiolucencies can be detected by CBCT with 100% sensitivity rate, as is common knowledge. The results of the present study confirm the previously noted pattern.[4]

Multiplanar views from a CBCT are useful not only in tracing the canal, but also in assessing a bifurcated or trifurcated canal (Fig. 2). In addition, knowledge of the location of the canal allows the surgeon to develop a safer surgical plan. A surgeon can eliminate the complication of guess-work when CBCT scans are available.[5]

When assessing benign tumours, all three dimensions were recorded by the multiplanar (axial, coronal, and sagittal planes) imaging of CBCT. In the present study, multiplanar views provided important information on the presence and extent of bone resorption, sclerosis of neighboring bone, cortical expansion and internal or external calcifications, and proximity to other vital structures.[6] (table 4, fig. 1,2) Multiplanar sections can provide adequate information of the size of a lesion. (fig. 3) Information on the spatial relationship of the lesion with other anatomic landmarks on such images is limited, and often difficult to interpret by two-

TABLE 1: AGE AND GENDER DISTRIBUTION

Serial no.	Age	Gender	
		Male	Female
1.	8-18	16	05
2.	19-28	16	10
3.	29-38	21	14
4.	39-48	28	13
5.	49-58	21	13
6.	59-68	23	10
7.	69-78	24	8
	Mean Age	**M:F =2:1**	

TABLE 2: GENDER DISTRIBUTION OF VARIOUS CYSTIC LESIONS

TYPES OF CYSTS	M	F	NO. OF CASES
RADICULAR CYST	10	11	21
DENTIGEROUS CYST	10	2	12
ODONTOGENICKERATOCYST(OKC)	3	3	06
ANEURYSMAL BONE CYST	01	00	01
RESIDUAL BONE CYST	2	1	03
STAFNES BONE CYST	01	00	01

TABLE 3 : Gender Distribution Of Various Jaw Pathologies

Pathologies	Male	Female	Total
SINUSITIS	10	14	24
OSTEOMYELITIS	20	6	26
FIBRO-OSSEOUS LESIONS	4	8	12
MAXILLOFACIALFRACTURES	14	01	15
SIALOLITHS	2	1	03
TMDS	37	36	73
OROFACIAL MALIGNANCIES	10	6	16

Fig.1 Radicular cyst

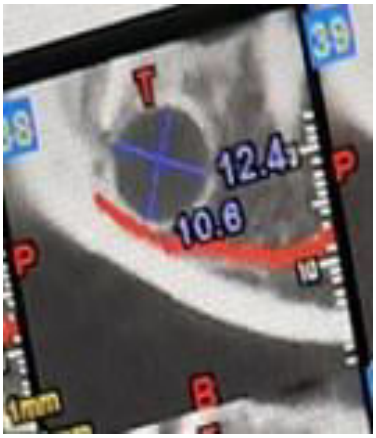

Fig.2 Residual cyst

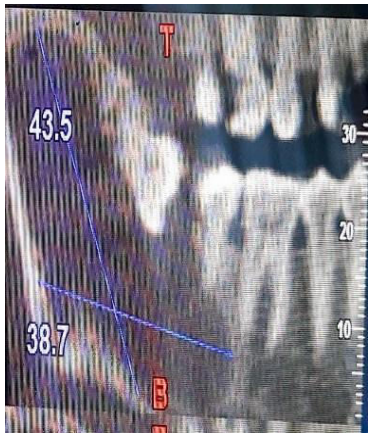

Fig.3 Dentigerous cyst

Fig.4: 3D reconstruction showing the ill-defined osteolytic lesion involving mandibular body

TABLE 4: CBCT FINDINGS IN DIFFERENT CYSTS

CBCT findings	Radicuar Cyst	Dentigerous Cyst	Odontogenic kerato cyst (OKC)	Aneurysmal bone cyst (ABC)	Residual Bone Cyst	Stafne's bone cyst
Location	Maxillary anterior region	Right mandibular posterior	Right and left mandibular posterior region	Maxillary anterior region	Mandibur right posterior	Mandibul arleft posterior
Number	solitary	solitary	Multiple / solitary	Solitary	solitary	Solitary
Margins	Well defined	Well defined	Well defined	Well defined	Well defined	Well defined
expansion	+	-	+	-	-	-
Effect on surroundin gstructures	+	-	+	+	-	-
Breach in continuity	+	-	+	+	-	-

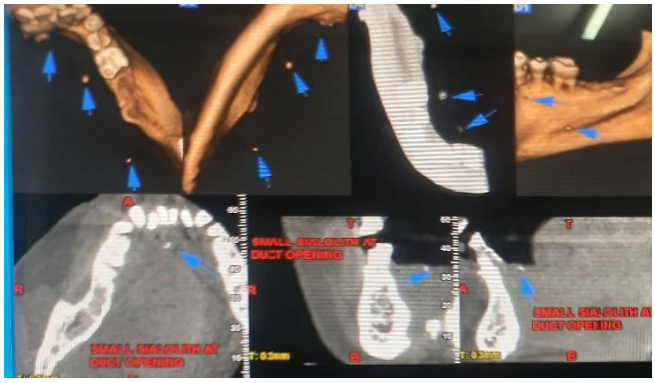

Fig.5 Multiple Sialoliths at duct of opening

TA B L E 5 : CBCT FINDINGS IN DIFFERENT PATHOLOGIES

CBCT FINDINGS	SINUSITIS	FIBRO-OSSEOUS LESIONS	SIALOLITHS	OROFACIAL MALIGNANCIES	TMDS
Location	Right Maxillary sinus with opacification in maximum cases	Left mandibular posteror region	Right submandibular region	Mandibular posterior	Both TMDS
Bone	+	+	-	+	+
Margins	Ill defined	Ill defined	well defined	Ill defined	Ill defined
Effect on Surrounding Structures	-	+	-	+	-

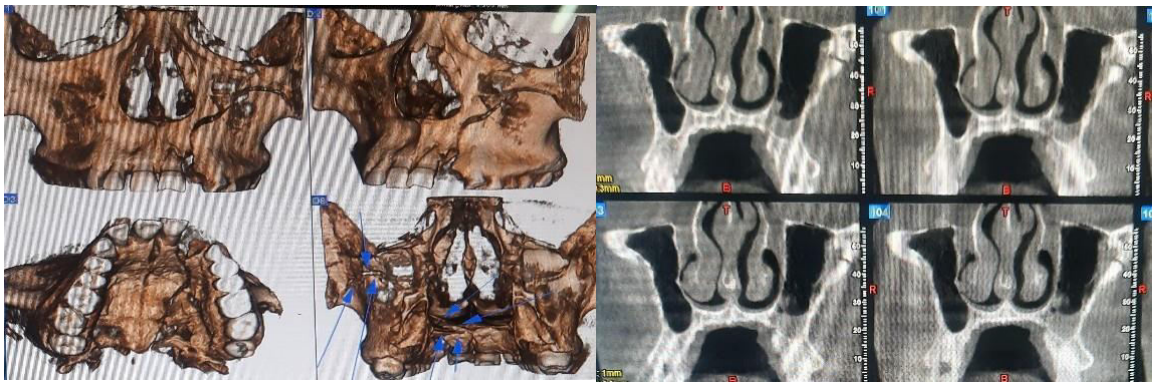

Fig.6 maxillary (arrow) and zygomatic arch (arrowhead) fractures.

TABLE 6 : FINDINGS OF TRAUMATIC INJURIES

CBCT FINDINGS	TRAUMATIC INJURIES / FRACTURES
Location	Maxilla > Mandible
Number	Multiple
Displacement of fracture segments	+
Effect on surrounding structures	Perforation in maxillary sinus
Displacement of normal landmarks	+
Malunion of fractures	+

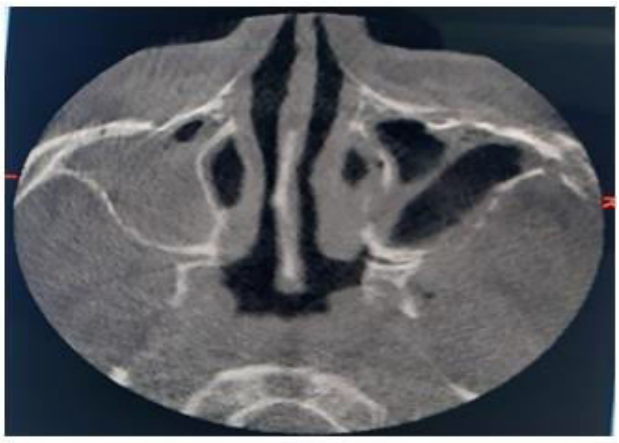

Fig 7 - Axial view depicting maxillary sinus

Fig 8 -3D image showing involving opacification osteolytic lesion of maxilla in Mucormycosis.

TABLE 7: FINDINGS OF OSTEOMYELITIS AND MUCORMYCOSIS

CBCT findings	OSTEOMYELITIS	MUCORMYCOSIS
Location	Both maxilla and mandible	Maxilla >mandible
Size	26.4(MD)X21.2(SI)X8.1(BL) (mm)	30.1(MD)X20.1(SI)X7.5(BL) (mm)
Altered trabecular pattern	+	+
Margins	+	+
Cortex expansion	-	-
Breach in adjacentstructures	+	+
Displacement of normal landmarks	+	+

Fig. 9- showing joint space measurements

dimensional radiograph such as panoramic radiograph and thus CBCT act as a diagnostic adjunct in the assessment of these lesions.[7]
Compared to smooth margins of cysts and benign tumours, the margins of malignant tumours are irregular. CT images can identify such irregular margins and provide information in the early stages of a malignant lesion. (fig. 4) while our study has the best advantage of CBCT that lies in the lower radiation dose and low cost and helped in better determining the borders of the lesions.[8]

When assessing inflammatory changes in the bone
Periosteal reaction and cortical destruction, as viewed on multiplanar images, can be useful in differentiating osteomyelitis radiographically from malignant lesions. If an aggressive infection persists for two weeks or more, the primary finding on a radiograph is a lytic lesion with irregular margins. In our study the patients reported with extensive bone exposure in the maxillofacial region when assessed with the 3d tool of CBCT. The bone appears of mixed density. With CBCT varying degree of bone changes were seen with lytic to mixed to sclerotic, where multiplanar slices are easy to adjust, thin layers of periosteal bones are better viewed compared to occlusal radiographs. In addition, small bony sequestra associated with osteomyelitis are better identified with cross- sectional imaging. (fig.7, 8) [9,10]

When assessing Jaw Fractures
The multiple jaw fractures with bone displacement may be better evaluated with CBCT images. In our study , various 3D and cross sectional views of CBCT scans were analysed for better assessment of interarticular fractures of the condylar head and fractures of the maxillofacial region such as zygomatic complex fracture, fractures of mandible and maxilla. Where maximum patients were having zygomatic complex fracture followed by condylar and angle fracture.(Fig. 6) [11]

When assessing Sinusitis, which is a common inflammatory disease involving the maxillofacial skeleton, is often of odontogenic origin. In our study, CBCT not only provided diagnostic information of the status of extension of periapical lesions into the maxillary sinuses, but also provided us reliable information on the septa of the sinus and useful presurgical information (fig 7) when planning sinus floor augmentation in preparation for implant placement also, where we can say that the conventional imaging such as Waters' view, is inadequate in providing such information. [12,13,14]

When assessing sialoliths, Solitary are more common than multiple sialoliths as compared to our study where multiple sialoliths were found in maximum number of cases. Henceforth CBCT can be used as the modality of choice for the demonstration of salivary ductal system and as an alternative toconventional sialography.[15] (Fig.5)

When assessing TMDs, the most common finding was condylar erosion and surface irregularity. Joint space was reduced in TMDs as compared to normal subjects and its was lower in right TMJ in males and left TMJ in females. CBCT found to be effective in assessing joint space measurements as well as determining all features of joint pathology that can be helpful in better patient evaluation and treatment planning.[16] (Fig.9)

Conclusion

With this high-resolution CBCT, the results of our study evaluated that bony invasion of the jaws by various pathologies can be assessed very accurately for the proper diagnosis and management of the lesions. However, even though CBCT images have superior quality, MDCT and MRI tests are still in needforsoft tissue evaluation pathologies.

Conflict of interest statement -

The authors have no conflict of interests to declare. All co authors agree with the content of manuscript , and there is no financial interest to report

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