A Questionnaire Cross-Sectional Study on Application of CBCT in Dental Postgraduate Students

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Summary

Background: CBCT is a new emerging imaging technique which uses a cone-shaped radiation beam that is centered on a 2D detector. It is now routinely evaluated for oral and para-oral disorders. It has been widely accepted in practice in radiology in academic and hospital settings and included in the curricula of some countries. The present study aimed to evaluate the awareness of and knowledge on CBCT among postgraduates.

Material/Methods: After obtaining permission and ethical clearance from concerned authorities, an anonymous survey on CBCT was conducted in a dental college by using a close-ended validated questionnaire to get to know the knowledge on CBCT among postgraduates in a dental college in India.

Results: A total of 100 volunteers participated but only 88 postgraduates responded to the questionnaire. Among the respondents, 54.5% were not using CBCT for diagnostic purposes at their work place. A total of 68.2% of respondents were partially aware of common terminologies used in CBCT. Most of the respondents were unsure about radiation exposure of CBCT when compared to other types of imaging. Almost nobody had any idea on relative importance of image characteristics. Only half of the respondents were willing to attend a hands-on course on CBCT interpretations versus pathology.

Conclusions: In the present study it was apparent that most of the respondents were lacking adequate knowledge on CBCT. Hence, there is an urgent need for more training programs on CBCT which would result in better diagnosis and treatment planning.

MeSH Keywords: Cone-Beam Computed Tomography • Cross-Sectional Studies • Dose-Response Relationship, Radiation

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Background

Since the discovery of X-rays in 1845, the field of imaging has evolved from the two-dimensional imaging modalities to the current advanced modalities including three-dimensional imaging enabling superior treatment options and virtual surgeries [1]. The era of "cut and see" has transformed into the era of "see and cut" because of the paradigm shift seen in the field of imaging today. The quality of imaging has not only improved the diagnostic accuracy of diseases but the quality care with regard to patient exposure and time consumption [1,2].

In CBCT dental imaging the scanner rotates around the patient's head, producing cone-beam-shaped radiation which obtains nearly 600 distinct images. A single rotation (360 degrees) over the region of interest acquires a volumetric data set. The scanning software collects the data and reconstructs it, producing a digital volume composed of three-dimensional voxels of anatomical data that can be then manipulated and visualized with specialized software [2,3].

In the present day, CBCT is an emerging imaging modality with an advantage of a rapid scan time, it is designed to produce cone-shaped beam limited to the head and neck region, reduce radiation doses when compared with CT and have interactive display modes that offer maxillofacial

Table 1. Response of individuals on the need of CBCT machine in their work place.

		Frequency	Percent	Valid percent	Cumulative percent
	Yes	81	92.0	92.0	92.0
Valid	No	7	8.0	8.0	100.0
	Total	88	100.0	100.0	

Table 2. Response of individuals on usage of CBCT for diagnostic purpose in their dental practice.

		Frequency	Percent	Valid percent	Cumulative percent
	Yes	40	45.5	45.5	45.5
Valid	No	48	54.5	54.5	100.0
	Total	88	100.0	100.0	

Table 3. Awareness of common terminologies used in CBCT like, FOV, SSV, MIP, Multiplanar reconstruction, DICOM images and etc.

		Frequency	Percent	Valid percent	Cumulative percent
	Not aware	22	25.0	25.0	25.0
	Partially aware	60	68.2	68.2	93.2
Valid	Fully aware	6	6.8	6.8	100.0
	Total	88	100.0	100.0	

imaging and multiplanar reformation, making them more useful at the work place of dental practices [4,5].

CBCT is indicated for diagnosis and treatment plan, for nerve tracing in cases of third molar extraction; it is a useful tool in implant placement, for maxillofacial surgeries, in sinus pathologies, in endodontics for locating additional roots and accessory canals and in detecting vertical root fracture, orthodontic cases and orthognathic surgeries, in evaluating cysts and tumors and in TMJ disorders and even used in forensic dentistry [5–7].

As CBCT is one of the extensively employed imaging modalities that has recently become a useful tool at a work place of dental practice [8–11]. The present study was conducted among postgraduates of dental specialty of oral medicine and radiology to assess their knowledge on CBCT.

A literature search revealed various studies that focused on the use of various digital systems in imaging and interpretation of CBCT images, but there was no study to present the awareness of and knowledge on CBCT among postgraduate students of Oral Radiology.

Material and Methods

An anonymous survey was carried among postgraduates of dental specialty of oral medicine and radiology in a dental college in India to access their knowledge on CBCT. The study protocol was reviewed by the Ethical Committee of Dental College and Hospital and was granted ethical clearance.

The investigators distributed the prepared validated questionnaire among delegates, i.e. staff and students from various colleges across India, who attended a CBCT hands-on course on a pre-decided date. A total of 100 volunteers participated in the study but only 88 postgraduates responded to the questionnaire which comprised of 14 close-ended questions. (sample of the Questionnaire is mentioned below). Respondents of either gender with age between 24–28 years, being students of the dental specialty of oral medicine and radiology in different colleges from both states (i.e. Telangana Andhra Pradesh), India were included in the study. Prior consent was obtained from the participants and their confidentiality was maintained. The completed questionnaires were collected, results obtained and tabulated. The results thus obtained were subjected to statistical analysis using SPSS software.

Results

Among 100 participants 88 volunteers responded to the questionnaire. Ninety-two percent of respondents felt that there was a need for a CBCT scanner at their work place (Table 1). A total of 54.5% of respondents said that they had not used or advised CBCT for diagnostic purposes in their cases (Table 2). Among all the respondents only 68.2% were

Table 4. Response of individual about CBCT radiation dose.

		Frequency	Percent	Valid percent
q10a How many full mouth series of IOPA does this scan equal				
Valid	Unsure	54	61.4	61.4
	1	4	4.5	4.5
	3–6	15	17.0	17.0
	10	4	4.5	4.5
	25	3	3.4	3.4
	50 or more	8	9.1	9.1
	Total	88	100.0	100.0
q10b How many panaromic exposures does this scan equal				
Valid	Unsure	55	62.5	62.5
	1	7	8.0	8.0
	3–6	11	12.5	12.5
	10	6	6.8	6.8
	25	2	2.3	2.3
	35	4	4.5	4.5
	50 or more	3	3.4	3.4
	Total	88	100.0	100.0
q10c how many days of background exposure does one scan equal				
Valid	1	6	6.8	6.8
	3–6	5	5.7	5.7
	10	7	8.0	8.0
	25	2	2.3	2.3
	35	1	1.1	1.1
	50 or more	3	3.4	3.4
	Total	88	100.0	100.0
q10d How many of these scan equals one head and neck CT scan				
Valid	Unsure	60	68.2	68.2
	1	4	4.5	4.5
	3–6	8	9.1	9.1
	10	9	10.2	10.2
	25	3	3.4	3.4
	35	1	1.1	1.1
	50 or more	3	3.4	3.4
	Total	88	100.0	100.0

Table 5. Response of individual about CBCT image characteristics.

		Frequency	Percent	Valid percent
q13a high spatial resolution				
Valid	Not important	7	8.0	8.0
	Moderately important	21	23.9	23.9
	Very important	29	33.0	33.0
	I dont know what that means	31	35.2	35.2
	Total	88	100.0	100.0
q13b high contrast resolution				
Valid	Not important	3	3.4	3.4
	Moderately important	21	23.9	23.9
	Very important	31	35.2	35.2
	I dont know what that means	33	37.5	37.5
	Total	88	100.0	100.0
q13c capability to adjust FOV				
Valid	Not important	3	3.4	3.4
	Moderately important	18	20.5	20.5
	Very important	33	37.5	37.5
	I dont know what that means	34	38.6	38.6
	Total	88	100.0	100.0
q13d capability to take/have short sacn times				
Valid	Not important	4	4.5	4.5
	Moderately important	13	14.8	14.8
	Very important	35	39.8	39.8
	I dont know what that means	36	40.9	40.9
	Total	88	100.0	100.0
q13e Image capture with image intensifier				
Valid	Not important	5	5.7	5.7
	Moderately important	9	10.2	10.2
	Very important	37	42.0	42.0
	I dont know what that means	37	42.0	42.0
	Total	88	100.0	100.0
q13f Image capture with flat panel screen				
Valid	Not important	2	2.3	2.3
	Moderately important	17	19.3	19.3
	Very important	28	31.8	31.8
	I dont know what that means	41	46.6	46.6
	Total	88	100.0	100.0

Table 6. Response of individuals about willing to attend CBCT programme in future.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Hand on course on CBCT equipment operations	10	11.4	11.4	11.4
	Hand on course on CBCT software applications	12	13.6	13.6	25.0
	Hand on course on CBCT interpretations versus pathologic images	44	50.0	50.0	75.0
	Hand on course on normal anatomy	6	6.8	6.8	81.8
	All	16	18.2	18.2	100.0
	Total	88	100.0	100.0	

partially aware of common terminologies used in CBCT, like FOV, SSV, MIP, MPR, and DICOM images (Table 3). Only 29.5% of the respondents were able to interpret CBCT images while 46.6% said that they would self-interpret the images and also relied on the reports given by medical radiologists. Among the questions related to the software used in the interpretation of CBCT images, a majority of the respondents (34.1%) were familiar with iCAT classic. Some of the respondents (i.e. 34.1%) said that they had no knowledge on the software used while some respondents (i.e. 34.1%) found that iCAT vision software is more user-friendly for interpreting CBCT images.

When questioned how many images they come across a month, 83.0% said that around 0-5 images. The majority of participants i.e. 53.4% said they never used CBCT scanners for 2D panoramic radiography while a few said 'rarely' (23.9%) and 'once in a month' (11.4%). Majority of respondents i.e. 45.5% never used CBCT in case of the third molar while a few reported rare use (31.8%) and once a week (11.4%). A total of 36.4% of respondents said they never used CBCT in diagnosing fracture cases while 27.3% said 'rarely', and 17.0% 'once a month'. Most of the participants, i.e. 42.0%, said that they never used CBCT for sinus pathologies while a few said 'rarely' (25.0%) and 'once a month' (22.7%). As much as 34.1% of respondents said that they never used CBCT for diagnosing cysts and tumors, followed by 25.0% 'once a month', and 21.6% 'rarely'. A total of 39.8% of respondents said that they never used CBCT for TMJ pathologies while a few said 'rarely' (25.0%) and 'once a month' (23.9%). Most of the respondents said that they never used or advised CBCT for implant cases (39.8%), orthodontic analysis (52.3%) and orthognathic surgeries (45.5%) or for endodontic purposes (47.7%). As much as 54.5% of respondents said that other medical professionals seek their opinion for CBCT of the maxillofacial region while 42.0% reported that those professionals seek their opinion 'sometimes'.

When enquired about the radiation exposure for CBCT, a majority of them were unsure about it as compared to other types of imaging (Table 4). Most of the respondents did not have any idea on image characteristics (Table 5). A

majority of respondents were willing to attend a CDE program on CBCT in future (Table 6).

Discussion

Imaging has experienced a paradigm shift from conventional to advanced in the recent years with the advent of numerous advanced imaging modalities which technically converted two-dimensional images into three-dimensional life-like images making interpretation and diagnosis more accurate.

CBCT scanners used in oro-facial imaging were first employed by Aria et al. and Moshiri et al., and since then CBCT has become a preferred imaging modality for various maxillofacial pathologies and treatment needs in dentistry [12–14].

As mentioned earlier, CBCT finds its applications in almost all areas of dentistry and is one of the most widely accepted imaging modality in the current practice. Owing to its recent recognition as an imaging modality, it is often found that little is known about its application, and especially about interpretation of the images using various software. This could be due to the advanced level of software knowledge as regards understanding and interpreting CBCT images. Hence, the current study was conducted to assess the knowledge on CBCT and its use among dental postgraduates in the specialty of Oral Medicine and Radiology.

In our study we found that most of the respondents felt a need of a CBCT scanner at their work place to help them in diagnosis and treatment plan. Moreover, a CBCT scanner can be very helpful in educational institutions for practical training purposes. A similar study conducted by Shishir Ram Shetty et al., among dentists in Mangalore found a 100% necessity of having a CBCT scanner in dental institutions [8].

In our study we found that most of the respondents did not use/advised CBCT for diagnostic purposes and only half of the participants were partially aware of common terminologies used in CBCT like FOV, SSV, MIP, MPR, and

Table 7. Typical effective doses for radiographs [18].

S. no.	Radiographs	Effective dose (μSv)	Equivalent background exposure (days)
1	Intraoral (full mouth)		
	D speed film	388	46
	F speed film/PSP	171	20
	CCD sensor	85	10
2	Extraoral		
	Panoramic	9–24	1–3
3	CBCT		
	Large field of view	68–1073	8–126
	Medium field of view	45–860	5–101
	Small field of view	19–652	2–77
4	Multislice CT		
	Head (conventional protocol)	860–1500	101–177
	Head (low dose protocol)	180–534	21–63

DICOM images. This can be attributed to the unavailability of CBCT at their work place. Most of the respondents in our study felt that there is a need for a CBCT scanner at their work place because it is important to get familiar with the handling of the scanner and to interpret more images rather than to have theoretical knowledge only. This is in accordance with the study by Kamburoĝlu et al., on Turkish dental students which highlighted the difficulties with acquiring knowledge on a given system without practical experience and thus the lack of CBCT units at institutions may constitute a significant factor contributing to students' unfamiliarity with this technology [15].

It was observed in our study that almost all the respondents felt a need for CBCT in dentistry. The limited use of CBCT as shown in our study for the purpose of nerve tracing, fracture cases, implant placement, sinus pathologies, cyst and tumors, TMJ pathologies and orthognathic surgeries could be attributed to the lack of CBCT units at institutions or workplace.

Dölekoğlu et al. conducted a study among Turkish dentists and found that they were referring for CBCT examinations in implant planning and diagnosing of cyst-tumors. That study was supported by the findings of Arnheiter et al. study [16,17].

Yalcinkaya et al. conducted a study on Turkish endodontists and he mentioned the following reasons for referring patients for CBCT: cyst/tumor 82.4%, implant planning 71.6%, trauma 50%, to indicate the resorption area 32.4%, to examine the morphology of a root canal 25.7%, to detect the exact place of broken files 16.2%, which was in contrast to the present study where most of the respondents were well aware of the applications of CBCT even though its use was limited due to the lack of the scanner at their work place [9].

In the present study we found that most of the respondents were unsure about their radiation exposure when compared with other imaging modalities. Moreover, a majority of the respondents did not have any idea on image characteristics of CBCT which could be attributed to the lack of CBCT units at their work place and even the lack of practical experience and unfamiliarity with image characteristics in image acquisition. A review of literature suggested that not all CBCT units produce the same dose of radiation. The effective radiation dose is dependent on the field of view (focused or large), power settings, rotation around the head (180° or 360°), etc. An effective dose for a radiographic examination and the background exposure is mentioned in the Table 7 [18,19].

Conclusions

We conclude from this present study that unfamiliarity with the use of CBCT among the post-graduates, due to an insufficient curriculum coupled with limited resources, led to decreased practical application thereof. What is more, we recommend that by increasing the number of continued education programs, the knowledge on CBCT and its application can be increased and thereby improve dental health care practices in future.

QUESTIONNAIRE

A Questionnaire Cross-Sectional Study on Application of CBCT in Dental Postgraduate Students.

1. Have you used CBCT for diagnostic purposes in your practice? (   )
   A) Yes   B) No
2. Do you feel that there is a need for a CBCT scanner at your workplace? (   )
   A) Yes   B) No
3. How aware are you of common terminologies used in CBCT, like FOV, SSV, MIP, multiplanar reconstructions, DICOM images? (   )
   A) Never heard   B) Partially   C) Fully aware
4. How do you interpret the CBCT images? (   )
   A) Self-interpretation always   B) I rely on an OMR specialist   C) A and B   D) I relay on radiologist reports
5. What brands of CBCT scanners you are familiar with? (   )
   A) iCAT classic   B) iCAT next generation   C) Kodak 9500   D) Newtom 3G
   E) Planmeca   F) Scanora 3D   G) Others   H) No idea
6. Which CBCT software is more user-friendly for interpreting CBCT images? (   )
   A)Carestream   B) NNT viewer   C) On demand   D) Romaxis
   E)   Xoran   F) iCAT vision   G) Others   H) No idea
7. On an average, how many CBCT images do you come across a month? ()
   A)0–5   B) 5–10   C)10–20   D) Above 20

8. The following is the list of preferential uses of CBCT in dentistry. Please indicate the frequency you refer for CBCT for each use in the space provided? (Please tick only one item in the column)

	Once a day	Once a week	Once a month	Rarely	Never
Do you prefer CBCT scanners for 2D Panoramic Radiography					
Third molar extractions (for nerve tracing)					
Fracture cases					
Implant placement					
Sinus pathologies					
Endodontic purposes (like locating additional roots and accessory canals)					
Orthognathic surgeries					
Cysts and tumors					
TMJ pathologies					
Orthodontic analysis					

9. Do other medical professionals seek your opinion on CBCT in maxillofacial region interpretation? (   )
A)   Rarely   B) Sometimes   C) Always

10. Do you have any idea about radiation exposure of CBCT for a small field of view when compared to other types of imaging mentioned below? (Please tick only one item in the column)

	Unsure	1	3–6	10	25	35	50 or more
How many full-mouth series of IOPA does this scan equal							
How many panoramic exposures does this scan equal							
How many days of background exposure does one scan equal							
How many of these scans equal one head and neck CT scan							

11. Do you have any idea about radiation exposure of CBCT for a medium field of view when compared to other types of imaging mentioned below? (Please tick only one itemin the column)

	Unsure	2	3–6	10	25	35	50 or more
How many full-mouth series of IOPA does this scan equal							
How many panoramic exposures does this scan equal							
How many days of background exposure does one scan equal							
How many of these scans equal one head and neck CT scan							

12. Do you have any idea about radiation exposure of CBCT for a large field of view when compared to other types of imaging mentioned below? (Please tick only one item in the column)

	Unsure	3–6	8	10	25	35	50 or more
How many full-mouth series of IOPA does this scan equal							
How many panoramic exposures does this scan equal							
How many days of background exposure does one scan equal							
How many of these scans equal one head and neck CT scan							

13. Please rate the relative importance of the following CBCT image/scanner characteristics? (please tick only one in the column)

	Not important	Moderately important	Very important	I don't know what that means
High Spatial Resolution				
High contrast resolution				
Capability to adjust FOV				
Capability to have short scan times				
Image capture with image intensifier				
Image capture with flat panel screen				

14. What type of CDE program would you like to attend on CBCT in future? ( )
    A) Hand-on course on CBCT equipment operations   B) Hand-on course on CBCT application
    C) Hand-on course on CBCT interpretations   D) Hand-on course on normal anatomy versus pathologic images

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