

How Ready are Our Students for Cone Beam Computed Tomography?

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Abstract

The aim of this cross-sectional study is to assess the level of skills of dental students in interpreting Cone Beam Computed Tomography (CBCT) images and their attitude towards CBCT.

A total of 232 participants-final year BDS students, interns, and postgraduate students answered a close-ended questionnaire containing 11 multiple-choice questions related to CBCT, based on few CBCT images. The difference in the students' responses according to education level was assessed using the chi-square test. We found that the majority of the respondents are adequately skilled in interpreting CBCT images, yet 69% of all participants demonstrated a lack of confidence in this field. About 83% of the participants felt that information given on CBCT at undergraduate level was inadequate, and 97% wished to have CBCT clinical postings incorporated into their undergraduate curriculum. Most of the participants were well aware of the importance of having a CBCT unit; thus have displayed a positive attitude towards the learning and use of this technology.

It is essential for dental students to be adequately skilled in handling CBCT scan procedures and interpreting CBCT images. More hours of lectures or clinical training regarding CBCT should become an integral part of the undergraduate curriculum to ensure the competency of dental students.

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Introduction

The transition of dento-maxillofacial imaging from 2D to 3D images has been made possible with the invention of cone beam computed tomography (CBCT) two decades ago¹. CBCT has varied application in dentistry: implant planning, orthodontic treatment planning, endodontics, and evaluation of mandibular third molar root proximity to the inferior alveolar canal and in the diagnosis of other oral and maxillofacial pathologies². In addition, CBCT can be also be used for evaluation of- trabecular pattern of mandible,^{3,4} impacted supernumerary teeth⁵, root fractures⁶, accessory canals⁷.

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Given the vast application of CBCT in modern day dentistry, it is of utmost importance for dentists to possess the necessary proficiency in handling a CBCT unit, selecting the proper CBCT sections and views, identifying normal and abnormal features on a CBCT scan and incorporating the data obtained into treatment planning. Through proper education and training, dental students can achieve this competency. Hence, this study was conducted to assess the level of skills of dental students, that is undergraduate (UGs) and postgraduate (PGs) in the interpretation of the CBCT images and to gain an insight into their learning attitude towards CBCT. The outcomes of the study can then be used to evaluate the need to further improve the students' knowledge, skills, and confidence regarding this promising technology.

Materials and methods

The study was conducted in a Dental

school in Southern Asia for over five months. A total of 232 dental students participated in the study, consisting of final year undergraduate students (UGs), interns, and postgraduate students (PGs) from all nine dental specialties. Institutional Ethics committee clearance (IEC360/2017) was obtained before the conduct of the study.

The participants filled a close-ended questionnaire containing 11 multiple-choice questions related to CBCT. The survey had two sections: Section A aimed to assess participants' skills in identifying and interpreting CBCT images; Section B aimed to investigate participants' attitude towards CBCT with a focus on its curriculum at undergraduate level. We procured anonymized images of extraoral radiographs and CBCT from the Radiology department archives. After obtaining informed consent from the participants, a PowerPoint presentation containing these images was shown to them using the projector screen of seminar halls or on laptops. Following this, each participant was requested to answer the questionnaire based on the images shown. The anonymity of the participants was maintained, and the participants did not receive any remuneration for contributing to the study.

All statistical analysis was performed using the SPSS software package (SPSS for Windows 10, IBM SPSS Statistics 20. Ink, Chicago). The difference in the students' responses according to education level was assessed using chi-square test for quantitative data. The frequencies and percentages were derived using descriptive statistics.

Results

Among the 232 dental students who participated in the study, 78(33.6%) were final-year undergraduate students, 77(33.2%) were interns, and 77(33.2%) were postgraduate students. A significant difference was observed between the responses for UG students, interns, and PG students for the items assessing the participants' CBCT interpretation skills, except item 2(III). There was no significant difference ($p>0.05$) in the attitude of dental students towards CBCT according to the level of education. (Table 1). Item 3 assessed participants' skills in interpreting CBCT images. Out of 232 participants, less than half of them

(30.2%, $n=70$) were able to make correct inferences from the images provided. For item 4, 76% ($n=177$) of the respondents graded the bone quality for both sites correctly. A significant difference was noted between the responses of the different groups of participants, ($P=0.023$) in that 90% ($n=70$) of final years' students graded the bone quality of both sites correctly compared to 68% ($n=52$) of interns and 71% ($n=55$) of postgraduate students.

Questions	Response	Final Year	Intern	PG*	P value
		N =78	N =77	N =77	
1. Which of the images do you think is a CBCT† image?	Figure 1A (Correct)	78(100.0)	71(92.2)	71 (92.2)	0.041
	Figure 1B (Incorrect)	0(0.0)	6(7.8)	6(7.8)	
	Figure 2A	0(0.0)	6(7.8)	6(7.8)	
2(I) Which of the images provide a better visualization of the mandibular canal?	Figure 2A	0(0.0)	6(7.8)	6(7.8)	0.013
	Figure 2B	78(100.0)	64(83.1)	65(84.4)	
	Both the same	0(0.0)	7(9.1)	5(6.5)	
	Cannot be appreciated in both	0(0.0)	0(0.0)	1(1.3)	
2(II) Which of the images provide a better visualization of the proximity of the pathology with respect to 48† to the inferior alveolar nerve?	Figure 2A	1(1.3)	5(6.5)	4 (5.2)	0.023
	Figure 2B (correct)	74(94.9)	59(76.6)	61(79.2)	
	Both the same	3(3.8)	13(16.9)	10(13.0)	
	Cannot be appreciated in both	0(0.0)	0(0.0)	2(2.6)	
2(III) Which of the images provide a better visualization of the proximity of maxillary root apices to the floor of maxillary sinus?	Figure 2A	21(26.9)	10(13.0)	18 (23.4)	0.185
	Figure 2B	53(67.9)	60(77.9)	50(64.9)	
	Both the same	3(3.8)	7(9.1)	7(9.1)	
	Cannot be appreciated in both	1(1.3)	0(0.0)	2(2.6)	

Table 1. Response of participants for questions 1&2.

Questions	Response	Final Year	Intern	PG*	Total	P value
		N =78	N =77	N =77	N(%)	
5. Do you think you are confident enough in interpreting a CBCT† image?	Yes	34(43.6)	20(26.0)	18(23.4)	72(31.0)	0.012
	No	44(56.4)	57(74.0)	59(76.6)	160(69)	
6. Do you think it is necessary to have a CBCT referral system in every dental clinic that does not have a CBCT unit?	Yes	73(93.6)	66(85.7)	65(84.4)	204(87.9)	0.165
	No	5(6.4)	11(14.3)	12(15.6)	28(19.1)	
7. Has adequate information on CBCT been included in the dental curriculum for undergraduate students?	Yes	24(30.8)	8(10.4)	7(9.1)	39(16.8)	<0.001
	No	54(69.2)	69(89.6)	70(90.9)	193(83.2)	
8. Do you think it is necessary to have CBCT clinical postings for undergraduate dental students?	Yes	75(96.2)	76(98.7)	74(96.1)	225(97.0)	0.559
	No	3(3.8)	1(1.3)	3(3.9)	7(3.0)	
9. Which year of dental education should include lectures on CBCT?	Preclinical	7(9.0)	5(6.5)	5(6.5)	17(7.3)	0.241
	Clinical	69(88.5)	69(89.6)	64(83.1)	202(87.1)	
	Doctoral	2(2.6)	3(3.9)	8(10.4)	13(5.6)	
	There is no need	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
10. Do you think CBCT is also useful in other medical fields?	Yes	75(96.2)	73(94.8)	75(97.4)	223(96.1)	0.101
	No	0(0.0)	0(0.0)	2(2.6)	2(0.9)	
	Don't know	3(3.8)	4(5.2)	0(0.0)	7(3.0)	
	No	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
11. Would you take the initiative to update yourself regarding information on CBCT from time to time?	Yes	78(100)	77(100)	77(100)	232(100)	
	No	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

Table 2. The responses of participants for question 5-11.

* Post-graduate students

† Cone-Beam Computed Tomography

‡ Mandibular right 3rd molar

When assessing the respondent's attitude towards CBCT, more than half (69%) of the participants felt less confident to interpret the CBCT images and this difference among groups was statistically significant. Almost 88% of respondents agreed that a CBCT referral system is necessary. Majority of the participants felt that adequate information on CBCT is not provided in the dental curriculum for undergraduate students. (Table 2) About 97% of the study participants thought that it was essential to have CBCT clinical postings for undergraduate students. Almost all the participants stated that didactic lectures on CBCT should be conducted in the clinical year. Most of the participants (96%) were aware of application of CBCT in medical fields. All participants unanimously agreed that updating the knowledge on CBCT is vital.

Discussion

CBCT has proven to be the third eye for dental practitioners, allowing dentists to arrive at an accurate diagnosis when conventional dental imaging modalities fail to deliver sufficient information for diagnosis. It is thus vital for dental graduates to at least garner some basic skills in interpreting CBCT images before they begin their dental careers. However, at present, little is known about how skillful dental students are in making correct inferences from CBCT images. Hence, our study aimed to investigate the level of skills dental students of our institution have in interpreting CBCT images and their learning attitude towards this technology in present day scenario. CBCT education has become more critical nowadays as it is slowly paving its way into the future of every aspect of dentistry. Various modes of learning such as CBCT lectures, clinical postings, continuing dental education or hands-on training program, etc. have been implemented to help future as well as practicing dentists gain knowledge, skills, and competency in this field.

The undergraduate curriculum, as prescribed by the Dental Council, has only one-hour of didactic class allotted for the teaching of specialized radiographic techniques and CBCT is included in it. Clinical training on CBCT is not done in many dental schools here, due to the prohibitive cost of acquiring a CBCT unit. To compound the issue, it is not mandatory as per council norms for dental school to have a CBCT unit^{8,9}.

In light of this, several studies have been conducted to assess dental students or practitioners' knowledge and attitude towards this increasingly popular form of dental imaging. A study by Shah et al.³ reported that knowledge regarding CBCT among dental students was quite superficial owing to insufficient practical exposure. Based on our study, irrespective of education levels, majority of the participants were able to distinguish the panoramic reconstruction of a CBCT scan from a traditional panoramic radiograph based on the absence of superimposition of surrounding anatomical structures as what would have appeared in a panoramic radiograph. As for skills in recognizing the various views of CBCT scans and interpreting the findings on those images, PG students seemed to have better skills than interns and final year students. This observation could be attributed to PG students' increased clinical exposure and experience in this field.

On the other hand, having been recently taught the concept of Misch classification of bone quality in the undergraduate Prosthodontics academic curriculum, final year students were able to grade the bone density for a dental implant site correctly better than Interns and PG students. It is a known fact that not all PGs have clinical experience in grading bone density other than those in the field of Prosthodontics and Implantology. This factor might have accounted for the relatively lower correct response among PGS.

We found that the majority of participants opined that they had not received adequate information on CBCT from the dental curriculum for undergraduate students. This result is in accordance with the study conducted by Kamburoglu et al.¹⁰ in which the majority of both UGS and PGS stated that the faculty courses did not provide adequate information on CBCT. On the contrary, Shetty et al.¹¹ found that most of dentists thought that there was a sufficient emphasis on CBCT during their undergraduate studies. On asked about the incorporation of lessons regarding CBCT into the undergraduate curriculum, most of our participants agreed that they should be included during the clinical phase. Similar results were found in studies conducted by Reddy et al.¹² and Faran et al.¹³, but is in contrast to reports of Noaman et al.¹⁴.

Besides, most of our participants felt that it is necessary to have CBCT clinical postings for

undergraduate dental students, as there is a lack of clinical demonstration of handling CBCT scan procedures. This finding is consistent with the conclusions drawn by Farooq et al.¹³ which stated that more than half of the participating dental students have no competency to handle the troubleshoots during CBCT scan. The author further concluded that there is an utmost need for CBCT units in hospital setups and that demonstrations of CBCT scanning procedures should be included in the dental curriculum. study by Aditya et al.¹⁵ among 50 dental practitioners including five experts in Oral Radiology also found that there is a need to develop a training module with standardized curriculum on CBCT for the dental specialists as there was a lack of such training program in their country.

The methods of data collection were different for final year students, interns, and PG. The images were projected on an LCD screen for the final year students while laptop computers and tablets were used to display the images to the interns and PG students. There could be a difference in the clarity and resolution of images projected by the different devices, thus possibly affecting each participant's perception of the images projected and is one of the drawbacks of the study.

Conclusions

CBCT may become an indispensable tool in the future for the proper diagnosis and treatment planning of oral health-related issues. Thus, dental students who will be future dentists should not only possess sound theoretical knowledge but also be adequately skilled in this cutting-edge technology. It is apparent in the results of our study that the majority of the dental students are adequately skilled in interpreting CBCT images yet demonstrated a lack of confidence in this field. They have also displayed a positive attitude towards the learning and use of this technology. They are eager to learn more about CBCT beyond what the present curriculum has to offer. Based on the inferences obtained from this study, clinical posting in the radiology department has been added as a part of the rotatory internship schedule in our institute. Similar targeted efforts to include more hours of CBCT lectures supported by clinical training in the curriculum might prove useful in ensuring students' competency in this field.

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Declaration of Interest

The authors report no conflict of interest.

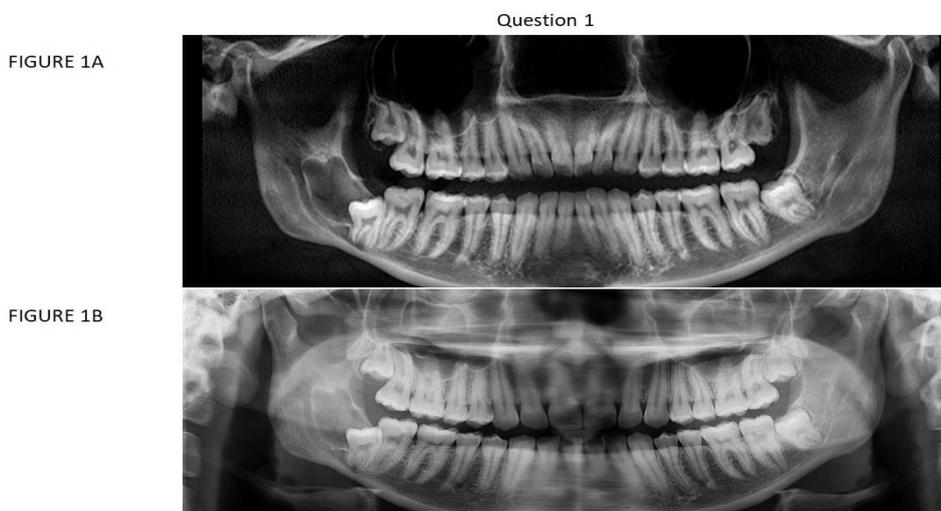


Figure 1A&1B: Cone Beam Computed Tomography (CBCT) and panoramic images of the same patient used in question 1.

Question 2 (I), 2(II), 2(III)

FIGURE 2A



FIGURE 2B



Figure 2A&2B: Panoramic and Cone Beam Computed Tomography (CBCT) images of the same patient used in question 2.

Axial View

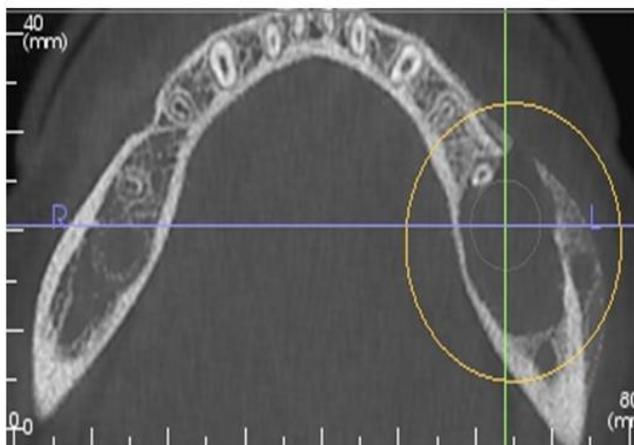


FIGURE 3A

Coronal view

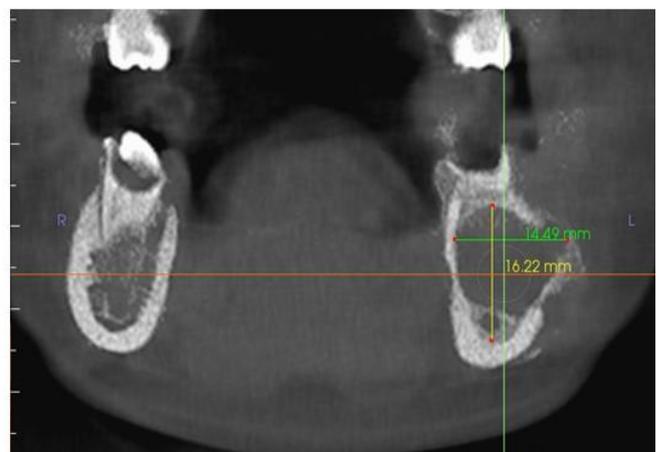


FIGURE 3B

Figure 3A&3B: CBCT images used in question 3 belonging to the same patient.

Figure 3A: Axial view, **Figure 3B:** Coronal view.

Question 4: FIGURE 4

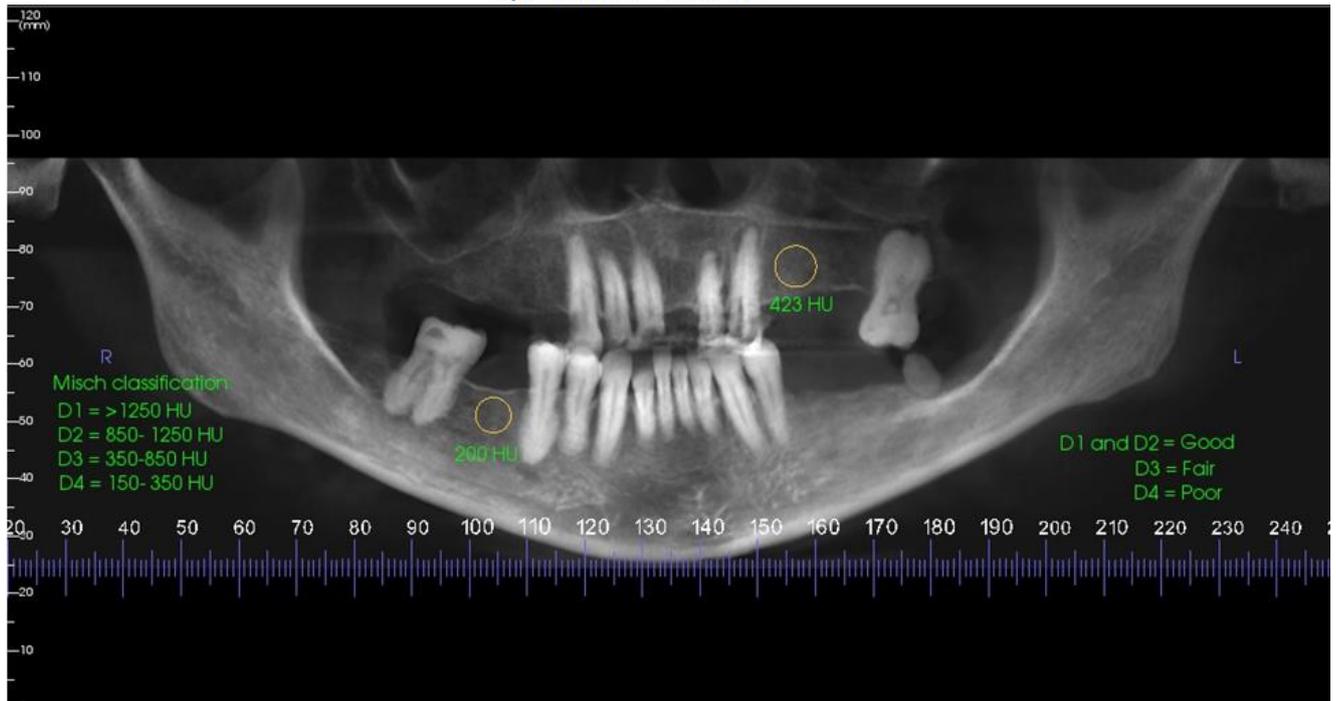


Figure 4: CBCT image depicting bone mineral density in Hounsfield units (HU) at 2 different sites on the maxilla and mandible respectively, along with Misch classification and its interpretation of bone quality

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