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RESEARCH ARTICLE

THE KNOWLEDGE AND AWARENESS ABOUT CBCT AMONGST DENTAL STUDENTS AT VARIOUS LEVELS OF EDUCATION IN TELANGANA REGION: A CROSS SECTIONAL SURVEY

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ABSTRACT

Background: - The current study aimed to investigate awareness, general attitude and perspectives of a sample of dental students belonging to various levels of education residing in Telangana region regarding their knowledge and future expectations of Cone Beam Computed Tomography (CBCT).

Materials and Methods: An anonymous questionnaire consisting of 11 questions was distributed among 365 dental students which included final BDS students, interns, and Post-Graduation (PG) students belonging to KNR University of Health Sciences, Telangana. They were contacted through E-mail and they have completed an online questionnaire. The data were collected, sorted and analysed in view of the objectives of the study, using descriptive analysis and Chi-square tests of significance.

Results: The results of this survey are indicative that education level and place of work had a significant effect on awareness regarding the use of CBCT in daily dental practice. It was found that out of 365 individuals who participated in the study, 135 of them were final year BDS students, 85 were interns and 145 were PG students. The rate of awareness about CBCT varied among the three groups with statistically significant difference ($P < 0.05$) for various criteria. **Conclusions:** This study showed that having a higher education level and being in a tertiary workplace improved CBCT knowledge which in turn increased the number of patient referrals when the indications justified it for better diagnosis. Observing the positive attitude, it was concluded that students should be provided with thorough practical knowledge and efforts should be made to improve their practical knowledge.

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INTRODUCTION

The introduction of Cone Beam Computed tomography (CBCT) for dento-maxillofacial region has provided a novel platform for diagnosis and treatment planning. In the past decade, it is probably the most revolutionary innovation in the field of dentistry that provided a three-dimensional view to the dentist for better diagnosis. As CBCT is the future of dentistry for diagnosis, treatment planning, and post treatment evaluation, there should be a thorough theoretical and practical knowledge of CBCT among dental students who are the future clinicians (Parashar, 2012; Ramakrishnan, 2014).

The rapidly growing use of CBCT in oral radiology raised our concern about the awareness of the importance of this specialty and the knowledge and attitude of all dental specialties toward CBCT usage, including the recognition of dosage limitations and the criticality of CBCT interpretations (Parashar, 2012). A developing imaging modality with the advantage of rapid scan time, CBCT, is designed to produce a cone-shaped beam limited to the head and neck region while reducing radiation doses compared with computed tomography (CT). CBCT also has an interactive display that allows imaging reformation, making it beneficial for dental practice (Parashar, 2012;

Ramakrishnan, 2014; Yalcinkaya, 2014; Shetty, 2015). CBCT is indicated for diagnosis, treatment planning and mandibular nerve tracing in cases of the third molar extraction. It is also a useful tool in implantology, maxillofacial surgeries, sinus pathologies, endodontics for locating additional roots, and accessory canals and for detecting vertical root fracture, orthodontics, orthognathic surgeries, evaluation of cysts and tumours, temporomandibular joint (TMJ) disorders, and even forensic dentistry (Ramakrishnan, 2014; Balabaskaran, 2013). As the usage of dental implant placement is becoming prevalent, the awareness about the usage of CBCT for treatment planning has become more important than ever for accurate treatment. To the best of our knowledge, no previous studies have evaluated dentists' awareness of this concern in our region. The aim of the current study was to investigate the awareness, general attitudes and perspectives of a sample of dental students belonging to various education levels (under graduation students, house surgeons and Post-Graduation students) knowledge and attitude regarding CBCT which can provide an insight for the necessity of practical knowledge about CBCT among dental students.

MATERIALS AND METHODS

This observational cross-sectional study was conducted through an online e-survey sent to various students residing in Telangana state and belonging to KNR University Of Health Sciences from September to November 2018. This survey was sent to 450 dental students (150 final year graduation students, 150 house surgeons, 150 Post-Graduation students) out of which 365 have responded to the survey (81.1% response rate). They were contacted by E-mail and through dental social discussion groups and completed an online questionnaire. Participants who only agreed to fill the anonymous self-administered questionnaire participated in the study. Amongst the 365 dental students who responded to the survey, 135 of them were final year BDS students (37.1%), 85 of them were house surgeons (23.2%) and 145 of them were post graduation dental students (39.7%). The electronic anonymous questionnaire was guided by previous studies but modified to consist of 11 questions [Table-1] (Strindberg, 2015; Shetty, 2015). The questions dealt with were gender of the participant, awareness about CBCT, education level, source of knowledge about CBCT, CBCT applications, awareness about difference in dosage between CBCT and other imaging tools, and application of CBCT in various fields. The participating dentists were ensured that the results of the study would be confidential and used only for scientific purposes. The data were collected, sorted, and cross-tabulated. They were analysed in view of the objectives of the study, using descriptive analysis. Data were analysed using SPSS software version 22.0.

RESULTS

Response rate: Totally, 450 questionnaires were distributed to the students, out of which 365 students responded and returned the filled questionnaire (response rate: 81.1%). No significant difference was found according to the gender of the participants for any of the questions. However, there was a significant difference depending on the level of education for most of the questions ($p < 0.001$).

Awareness about cone-beam computed tomography: Among the 365 respondents, 285(78.08%) of them were aware of CBCT usage in dental practice. There was statistically significant difference between different groups according to the education level with $p < 0.001$.

Source of knowledge [Table-2]: Majority (87.7%) of the students obtained the knowledge of CBCT through faculty lectures/text books. However, there was statistically significant difference ($p = 0.05$) between the answers of Under graduation students (82.27%), house surgeons (90%), and Post graduation students (89.7%). In addition, 6.6% of participants learned about CBCT through conferences and 5.6% of them through the internet, with statistically significant differences ($p = 0.05$) in the responses of Under graduation students, house surgeons, and Post-graduation students.

Attendance of workshop [Graph-1]: It was found that only 2.53% of under graduates, 8.5% of house surgeons and 27.2% post graduate students who participated in this study were found to have attended workshops on CBCT. Hence, it can be said that there was statistically significant difference in between groups (with $p < 0.001$).

Advantages of cone-beam computed tomography[Table-3]: Lower radiation dose was cited as the most important advantage of CBCT over medical computed tomography (CT) (74.7%, $n = 213$) and less space occupied by it was the least important advantage (27.4%, $n = 78$), cited by the participants. There was a statistically significant ($p = 0.01$) difference between the responses according to education level ($p < 0.018$). More than half of the Post graduation students (56.41%, $n = 66$) were in favour of lower radiation dose being the most common advantage as compared to 42.7% ($n = 41$) and only 34.02% ($n = 33$) IVth year students.

Radiation dose and risk from CBCT in comparison to conventional dental radiograph [Graph-2]: About 67.7% ($n=193$) participants felt that the radiation dose and risk from CBCT is higher than conventional dental radiography (IPOA, bitewing, panoramic and planar skull projections. Almost 13.6% ($n=39$) contradicted to this statement while 18.6% ($n=53$) had no idea about radiation risk.

CBCT offers enhanced diagnosis at lower dose than conventional CT scan: It was found that 72.3% ($n=206$) respondents felt that CBCT offers enhanced diagnosis at lower does compared to conventional CT scan, 5.9% ($n=17$) contradicted, whereas 21.7% $n=62$ were not sure whether this statement was true or false.

Extent of cone-beam computed tomography use in near future: More than 2/3 rd of the participants (71.2%, $n = 203$), comprising 81% of ($n = 64$) IVth year BDS students, 70% of ($n = 49$) house surgeons, and 66.2% of ($n = 90$) PGs, believed that CBCT would be commonly used in routine dental practice in near future in selected cases and 25.2% ($n=72$) suggested its wide use. A few participants (10.97%, $n = 34$) did not have any idea regarding the extent of the use of CBCT [Table 4]. The opinion regarding these selected dental applications differed significantly among the groups ($p = 0.003$).

Attitude toward cone-beam computed tomography: The majority of participants (72.98%, $n = 208$) desired to use CBCT in their future dental practice. Only a few (1.4%, $n = 4$)

told that they did not look forward to using this modality in their future professional career while 25.61% (n = 49), were not sure about the usage of CBCT. There was no statistically significant difference between the responses according to the education level (p = 0.08).

Indications of cone-beam computed tomography[Table-5][Graph-3]. The most common indication for the use of CBCT was given as implant planning (81%, n=231) cyst and tumour cases (80.3%, n=229) followed by TMJ radiography(66.3% n=189), orthodontic assessment (54%, n=154) and evaluation of impacted tooth (51.9% n=148) There was no statistically significant difference between the responses between the three groups (p = 0.16)

DISCUSSION

Studies evaluating dentists' knowledge about dental radiology have focused mainly on digital systems and radiation protection.⁸ The present study assessed dental students belonging to various education levels specifically for CBCT knowledge and attitudes. With the aim of keeping up with this technology, which aids dentists and their patients, we used a questionnaire to gauge the level of knowledge regarding CBCT among a sample of dental students residing in Telangana state region and belonging to three different education levels. Most participants were female, which reflects the demographics of the faculties as a whole. However, no significant differences in responses were found between female and male dentists. In a study by Kamburoglu *et al.*, seminars were the main source of CBCT knowledge for dental students, and the results obtained in the present study were concurrent with the above mentioned study.

The level of education was significantly associated with an increase in CBCT knowledge. This can be explained from the results of a study by Whitesides *et al.*, who found that oral maxillofacial surgery residents were actively involved in CBCT use during their postgraduate training, which increased their education and experience in image interpretation.⁹ Our study also showed that CBCT knowledge is significantly different when stratified according to education level, wherein it was found that among the 365 respondents, 285(78.08%) of them were aware of CBCT usage in dental practice. There was statistically significant difference between different groups according to the education level with p<0.001 which indicates different levels of interest in CBCT knowledge. The study also showed that dental practitioners refer to CBCT more frequently when they have CBCT knowledge (P = 0.0001). Radiology learning is intimately linked with the study of anatomy and pathology on radiographic images, which requires advanced knowledge of anatomy, together with advanced knowledge of digital radiography and a subsequent shift from hard- to soft-copy reporting.¹⁰ Having an implant was the indication with the highest frequency, followed by impaction and jaw pathology at equal frequency and then TMJ, endodontics, and other indications.¹¹ Strindberg *et al.* also found that an implant was the indication with the highest frequency; it was markedly high in Sweden compared with Norway, where impaction was the second highest indication, followed by jaw pathology, a pain-related condition, and other indications,⁶ similar to the responses of the present study. In this study, we addressed dose awareness by means of a simple question to determine dental practitioners' expectations about CBCT doses.

In general, according to the American Academy of Oral and Maxillofacial Radiology, doses will differ according to the recommended examination. If an implant is going to be placed, the amount of radiation received from a CBCT of the jaws varies from approximately 18–200 μ Sv, depending on the size of the field of view, the resolution of the images, the size of the patient, the location of the region of interest, and the manufacturer settings (Pauwels, 2012). The effective dose for a panoramic radiograph, in contrast, is conservatively approximately 14 μ Sv (Ludlow, 2007). In our study, almost 67.7% of the participants were aware that the CBCT scan involves a higher dose than that of a panoramic radiograph. Garlapati *et al.* showed that, compared with other dental practitioners, general dentists preferred panoramic radiographs and CBCT. Panoramic radiographs were, however, advocated for fixed partial denture planning, whereas CBCT was advocated for implant planning. Moreover, there had recently been a drastic increase in the preference for CBCT over orthopantomography.¹⁴ In addition, Pertl *et al.* showed that panoramic radiographs using steel balls as a calibration reference seem to be reliable only in a standard situation, but in more difficult cases, CBCT should be used to determine available bone volume (Pertl, 2013).

At present, few dental schools teach CBCT scan acquisition and implant planning software applications to pre-doctoral students. Many dental schools, however, prepare students for CBCT image interpretation (Parashar, 2012; Adibi *et al.*, 2012). In their study, Adibi *et al.* stated that it is the responsibility of dental educators to integrate this technology into their curricula in a timely manner so that the next generation of oral health providers and educators will be competent in using this technology for the best interest of patients (Adibi, 2012). When compared to conventional CT scanners, CBCT reduces the effective dose of radiation up to 98% (Shetty, 2015). Instead of pixels, the image is displayed in isometric voxels which provides high resolution, accuracy, and reproducibility to CBCT images (Strindberg *et al.*, 2015; Dölekoglu, 2011). The other advantages include beam limitation, shorter scanning time, minimum patient discomfort, and reduced image artefact (Parashar, 2012; Ramakrishnan, 2014). The compact size, relatively lower cost when compared with medical CT and easy maintenance makes it suitable for dental clinics (Kamburoglu, 2011). However, drawbacks of CBCT include beam hardening, scatter from dental materials, and poor soft-tissue contrast (Whitesides, 2015). CBCT is useful in almost all areas of dentistry. The indications of CBCT include implant dentistry, evaluation of jaws for cysts and tumors, orthodontics, TMJ examination, paranasal sinus examination, assessment of third molars, and its relation to mandibular canal before disimpaction, trauma cases, and endodontics (Vuchkova, 2011; Shah *et al.*, 2016). Seeing the high accuracy in diagnosis, usefulness in treatment planning and having long list of advantages and indications in the field of dentistry, CBCT is the future of dentistry for diagnosis, treatment planning, and posttreatment evaluation. In India, although the number of CBCT units are increasing in the private sector, the appropriate use of CBCT is possible only if dentists and dental students have adequate knowledge about it. All the dental colleges in India come under one statutory body, the Dental Council of India (DCI). As per this statutory body regulation (Adibi, 2012), all the dental colleges should follow the DCI-specified curriculum, should have prescribed technical and clinical requirements and should follow the same examination pattern.

Table 1. questionnaire used in the survey

1.	Gender : Male () Female ()
2.	Education level: Final year BDS () House surgeon () Post Graduate ()
3.	Are you aware of cone beam computed tomography (CBCT) used for dent maxillofacial region? Yes () No ()
4.	How did you get to know about CBCT? Faculty lessons/ Textbook () Conference () Internet ()
5.	Do you attend any workshops regarding CBCT ? Yes () No ()
6.	Please mark the following advantages of CBCT over medial CT (You can choose multiple options) Lower radiation dose () Shorter scanning time () Less expensive () Occupies less space () Data processing can be done on personal computer () Image processing is easier due to the limited beam ()
7.	The radiation dose and risk from CBCT is generally higher than the conventional dental radiography (IOPA, Panoramic...) but lower than conventional CT scans True () False () No idea ()
8.	CBCT offers enhanced diagnosis at lower dose than CT ? Yes () No () May be ()
9.	To what extent do you think CBCT will be used in routine dental practice in the near future In all imaging () Only in selected cases () It will not be commonly used ()
10.	Would you choose to use CBCT in your future professional career? Yes () No () May be ()
11.	For what cases would you choose to use CBCT? (You can choose multiple options) Implant dentistry () Evaluation of impacted teeth () Evaluation of patients with tumour or cysts () Orthodontic assessment () TMJ imaging () No need ()

CBCT=Cone-beam computed tomography; IOPA= Intra Oral Peri Apical radiograph. CT=Computed tomography; TMJ= Temporomandibular Joint

Table -2: Source of knowledge about CBCT

Education level	How did you obtain information regarding CBCT?			P value
	Faculty/Textbooks	Conferece	Internet	
Final BDS	65(82.3%)	7(8.86%)	7(8.86%)	0.048
House surgeons	63(90%)	6(8.5%)	1(1.4%)	
Postgraduates	122(89.7%)	6(4.4%)	8(5.9%)	
total	250(87.7%)	19(6.6%)	16(5.6%)	

CBCT=Cone-beam computed tomography

Table 3. Response about Advantages of CBCT

Please select the following advantages of CBCT over medical CT (you can select multiple options)	Final BDS	House surgeons	Postgraduates	Total	P value
Data processing can be done on personal computer	34(43%)	37(52.8%)	73(53.7%)	144(50.5%)	0.018
Image processing	30(38%)	44(62.8%)	65(47.8%)	139(48.7%)	
Less expensive	14(17.7%)	13(18.5%)	44(32.3%)	71(52.6%)	
Low radiation	59(74.7%)	49(70%)	105(77.2%)	213(74.7%)	
Occupies less space	15(19%)	20(28.5%)	43(31.6%)	78(27.4%)	
Short scan times	46(58.2%)	38(54.3%)	64(47%)	148(51.9%)	

Table 4. Responses regarding scope of CBCT in routine dental practice in the near future

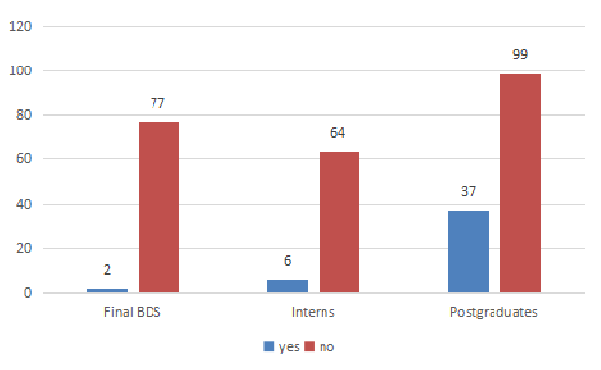
Educational level	To what extent do you think CBCT will be used in routine dental practice in near future?			P value
	all areas	selected areas	not commonly used	
Final BDS	11(13.9%)	64(81%)	4(5.06%)	0.003
House surgeons	17(24.3%)	49(70%)	4(5.7%)	
Postgraduates	44(32.3%)	90(66.2%)	2(1.4%)	
Total	72(25.2%)	203(71.2%)	10(3.5%)	

CBCT=Cone-beam computed tomography

Table-5: Indications of cone beam computed tomography (you can choose multiple options)

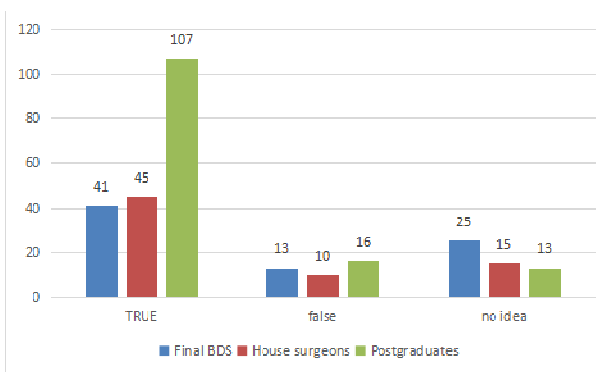
For what cases you choose to use CBCT in your future clinical dental carrier?	Final BDS	House surgeons	Postgraduates	Total	P value
Evaluation of pathologies like Cyst and Tumors	63(79.7%)	57(81.4%)	109(80.1%)	229(80.3%)	0.164
Orthodontic assessment	49(62%)	32(45.7%)	73(53.7%)	154(54%)	
TMJ Imaging	53(67.1%)	51(72.8%)	85(62.5%)	189(66.3%)	
Impacted teeth evaluation	35(44.3%)	33(47.1%)	80(58.8%)	148(51.9%)	
Implant Imaging	55(69.6%)	56(80%)	120(88.2%)	231(81%)	

CBCT=Cone-beam computed tomography; TMJ= Temporomandibular Joint



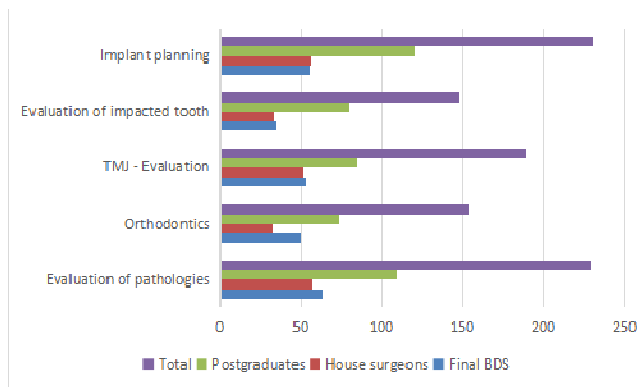
CBCT=Cone-beam computed tomography

Graph 1. Number of people who attended workshop on CBCT



CBCT=Cone-beam computed tomography

Graph 2. Response about Radiation dose and risk from CBCT in comparison to conventional dental radiograph



CBCT=Cone-beam computed tomography

Graph 3. Uses of CBCT in Dentistry

As per DCI specifications, (Lopes, 2017) BDS curriculum includes only one theory hour to educate the students regarding the specialized radiographic technique, and CBCT is taught as a part of it. DCI has still not made the CBCT scanner as mandatory equipment in its technical and clinical requirements. Due to this reason and also due to the cost factor involved in the installation of CBCT scanner, even though the importance of CBCT has been understood, many dental colleges in India are presently not having a CBCT unit. Hence, in India, the postgraduate dental radiology courses and undergraduate dental radiography teaching are presently providing adequate training in two-dimensional intraoral radiography, panoramic imaging, and other skull imaging modalities. As a result, many PGs may have limited knowledge about CBCT. Currently, many private imaging centers have installed CBCT scanner units. However, with limited theoretical and practical exposure to the dentists, the

benefit from this new technology may not profit the patients. Hence, the present study was focused to gather the information regarding dental students' approach to this promising new imaging modality.

In the present study, the students were broadly categorized into three groups: (i) Final BDS students who are learning and developing their clinical skills, (ii) interns who are about to begin their professional careers, and (iii) postgraduates who are specializing their proficiencies. The different phases of learning were thought to affect their knowledge and attitude toward the upcoming trends in the field of dentistry. The positive aspect was that all the participants, irrespective of their level of study, had at least some idea regarding the use of CBCT for dento-maxillofacial region. Statistically significant differences were noticed in responses to almost all the questions as per the level of education. To begin with, the source of information was limited to faculty lecture for most of the UGs whereas multiple sources were available for the PGs in addition to their classes. Horizons of knowledge were also becoming wider according to the education level when the knowledge regarding advantages and extent of use of CBCT was tested. As the PGs are more exposed to the recent advancements through seminars, workshops, and training programs, their knowledge was found to be sounder than that of the undergraduates.

When depth of their knowledge was analysed, many answers were suggestive of quite superficial knowledge of the students. The lack of practical exposure was reflected as the main cause for limited knowledge of the students. In our study, all the participants had heard about CBCT used in dental practice. The study conducted by Dölekoglu et al. (2011) showed that 56% of the general dentists had knowledge and 30% of them had referred their patients for CBCT. Another study conducted by Yalcinkaya et al. (2014) evaluating knowledge and attitude of endodontists demonstrated that 66.7% of the endodontists had knowledge about CBCT and 41.9% of them had referred their patients for CBCT. In both of these studies, (Dölekoglu, 2011; Yalcinkaya, 2014) lower radiation dose was given as the most important advantage of CBCT over CT. This result was similar to our study. The general dentists gave implant planning as a most common indication followed by the evaluation of cyst and tumors (Dölekoglu, 2011; Zain-Alabdeen, 2018). The present study too showed similar results. When the attitude of the students was evaluated, many of them were looking forward to adopt this newer modality as a part of their future professional career.

Conclusions

This study showed that having a higher education level and being in a tertiary workplace produced improved CBCT knowledge among dentists, and better knowledge of CBCT increased referrals to CBCT if indications justified it. With the increased demand for CBCT, there have been more frequent changes in diagnosis and treatment plans. Even though all of the students had heard about CBCT in dental practice, when evaluated in depth, it was found that their knowledge regarding CBCT is very much of theoretical aspect and is superficial. A similar type of survey needs to be conducted among students of different colleges across the country to evaluate the knowledge regarding this new technology. The results obtained by this present study are indicative towards the need of efforts by authorities such as DCI and the universities to provide a

CBCT unit in the radiology department in every institution. The curriculum should be revised and more theory time should be allotted to allow in-depth teaching of CBCT to the students.

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