Original Article

Assessment of Practice and Awareness about Applications of CBCT Imaging amongst Dental Professionals in Uttarakhand: A Questionnaire Study

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ABSTRACT

Introduction: With the consistent increase in the number of cone beam computed tomography (CBCT) centres in various cities across India; CBCT is being routinely employed as part of radiographic investigations. The assessment of awareness, knowledge, and attitude regarding CBCT among dental practitioners is important to ensure the maximum and appropriate use of this diagnostic modality. The study aimed to assess the usage of CBCT in routine clinical practice by dental professionals.

Methodology: A structured questionnaire comprising of 15 questions was given to 127 dental practitioners. The responses were assessed as per the type of their dental practice. Descriptive analysis of the data thus obtained was carried out.

Results: Results demonstrated that 96.1% were aware of CBCT as an imaging modality. Of these, 53.3% had used or were using CBCT in their dental practice. 68.8% of dental practitioners gained knowledge of CBCT as part of their dental curriculum and 18.9% gained their knowledge through continued dental education. However, lacunae did exist in the applications of CBCT over other two-dimensional imaging modalities; 87% of the participants perceived a need for a special training to use CBCT optimally in their practice.

Conclusion: This study emphasizes the positive attitude of dentists towards CBCT. Introduction of CBCT machines into the curriculum and hence to the dental teaching institutions would not only make the practitioners better trained for the optimum use of this imaging modality but also will make it more easily available and affordable to the dental patients.

INTRODUCTION

Cone beam computed tomography (CBCT) also known as C-arm CT, cone beam volume CT, or flat panel CT is a recent and advanced imaging modality and has introduced a newer realm in the field of dento-maxillofacial imaging. It has significantly increased the radiographic details available to the dental practitioner as compared to conventional two-dimensional imaging modalities. CBCT requires higher scan time than conventional tomography of the jaw bones and relatively higher radiation exposure.[1] However, in comparison to conventional CT (computed tomography), CBCT offers distinct advantages such as rapid scan time (10-70 seconds for complete scan), reduced area of irradiation and reduced dose of radiation.[1-3] Equipment used for CBCT are more economical and require a lesser foot space than those used for conventional CT.[4,5] CBCT uses a cone or pyramid shaped X-ray beam and acquires all the volumetric data in a single rotation around the area of interest. Multi-planar images are thus produced by filtered back projection of the data acquired from that volume. These multi-planar images can then be reconstructed into three-dimensional images for analysis.[3-5]

The various applications of CBCT in dentistry include an assessment of the jaws for the placement of dental implants, examination of teeth and facial structures for orthodontic treatment planning, evaluation of the temporo-mandibular joints for osseous degenerative changes, evaluation of the proximity of mandibular third molar teeth to the mandibular canal prior to extraction,

and a detailed evaluation of teeth and bone for presence of signs of infection, fractures, cysts and tumors.[6,7] CBCT has also found its application in the practice of endodontics to assess morphological aberrancies in root canals, root fractures, and root resorptions that may not be visualized in conventional intraoral radiographs.[8] CBCT quantifies the volume of anatomic structures and provides a measurement of linear distances and angulations.[9-10] However, the shortcomings of CBCT include a limited soft tissue contrast, scatter, and beam hardening artefacts from metallic restorations.[11]

Even though CBCT produces images of high diagnostic quality, they require a substantial level of expertise for interpretation. This would imply that the untrained dental practitioner is likely to have a significant error rate in the interpretation of CBCT images, thus resulting in a high percentage of missed or false diagnoses.[12]

Despite the importance of CBCT, very few studies have assessed a dental practitioner's knowledge and attitude towards it. Therefore, the present study was designed to use a questionnaire to gauge the knowledge and attitude among the undergraduate and postgraduate dental practitioners of Uttarakhand, India, with regards to CBCT and its applications. It was also aimed to assess the usage of CBCT in routine clinical practice by dental professionals.

METHODS

A study to evaluate the knowledge, attitude, and practice of CBCT was carried out amongst 204 graduate and post graduate dental practitioners through a self-administered questionnaire. Out of which the responses from 127 participants that comprised of dental professionals of various specialties practicing in the state of Uttarakhand, India were included in the study. The responses from the remaining 77 participants were excluded from the study as they were not practicing in Uttarakhand. Among the selected 127 participants, 62 were dental graduates and 65 were postgraduates.

The questionnaire consisting of fifteen questions was formulated to assess various aspects about the applications of CBCT that were clinically relevant (Table 1). The questions 1-3 were designed to know the nature and the application of CBCT in the respondent's practice. Questions 4 and 5 were constructed to evaluate the need and the mode of training acquired by the respondents. Questions 6-9 were designed to assess the respondent's

preference of CBCT over conventional methods in various clinical applications while questions 10 and 11 were to review his/her ability to optimally use the CBCT for implant site assessment and planning. Questions from 12 to 15 were formulated to assess the knowledge about CBCT armamentarium as compared to the respondent's current knowledge about other imaging modalities. The data collected was sorted and tabulated followed by descriptive analysis.

RESULTS

The participants of this study were practicing dentistry at either a hospital or teaching institution or as private practitioners (Figure 1). Though 96.1% of the respondents were aware of the use of CBCT in dental practice; only 53.3% of them were using or had used CBCT in their dental practice. Quite a few respondents utilised CBCT for more than one dental application. Implant site assessment (70.8%), cyst and tumor evaluation (40%) were the major applications for them using CBCT in their routine practice. Other dental applications where CBCT was employed by the respondents included impacted teeth (38.5%), maxilllofacial trauma (36.9%), endodontics (27.7%), craniofacial anomaly (18.5%), salivary gland disorder (9.2%), and any other (3.1%) (Figure 2). Our results showed that 68.8% of the dental practitioners gained knowledge regarding CBCT during their undergraduate or post graduate training and 18.9% gained their knowledge through continued dental education (CDE), while a smaller percentage of practitioners acquired their knowledge through the internet and peers (Figure 3). Eighty seven percent of the participants were of the opinion that there is a need for a special training to use CBCT optimally in their practice.

Among the participants of this study, 90.6% of the dentists were using dental implants for dental rehabilitation of their patients and 48.7% of these respondents used CBCT for implant site assessment and planning while 51.3% used other imaging modalities. Out of the 88.2% of the total respondents who practiced orthodontics, only 3.6% used CBCT for orthodontic treatment planning, while 96.4% of the practitioners preferred lateral cephalogram and orthopantomograph.

Endodontics was practiced by 97.6% of the respondents. Of those participants practicing endodontics, 95.2% used intraoral periapical radiographs for radio-diagnosis and treatment planning. Only 4.8% used CBCT during

Table 1: Self-administered questionnaire answered by the participants

No	Question	Response	
	What do you do?		
	a. Private practice		
	b. Institutional practice (Teaching)		
	c. Group practice (Hospital)		
1.	Are you aware of the use of CBCT in dental practice?		
	a. Yes	b. No	
2.	Have you used CBCT in your dental practice?		
	a. Yes	b. No	
3.	If yes for Q.2, what purpose do you prescribe it for?		
	a. Implant site assessment	b. Cysts and tumor	c. Endodontics
	d. Maxillofacial trauma	e. Impacted teeth	f. Craniofacial anomalies
	g. Salivary gland disease	h. Any other	
4.	How did you gain knowledge regarding CBCT?		
	a. During Graduation/Post-graduation	b. CDE programs	c. Internet
	d. From peers		
5.	Do you think you need special training prior to the use of CBCT in your practice?		
	a. Yes	b. No	
6.	For implant placement which radiograph do you use?		
	a. IOPA	b. OPG	c. CBCT
7.	For orthodontic treatment planning which radiograph do you use?		
	a. Lateral Cephalogram	b. OPG	c. CBCT
8.	For endodontic treatment which radiograph do you use?		
	a. IOPA	b. OPG	c. CBCT
9.	Are you aware of simulated implant placement on CBCT images?		
	a. Yes	b. No	
10.	Have you used implant simulation in your clinical practice		
	a. Yes	b. No	
11.	If yes to Q. 10, How do you perform the simulation?		
	a. Depend on Radiologist	b. Do it yourself	
12.	CBCT has less radiation exposure than CT?		
	a. Yes	b. No	c. Don't know
13.	CBCT has less radiation exposure than OPG?		
	a. Yes	b. No	c. Don't know
14.	CBCT requires lesser time than OPG?		
	a. Yes	b. No	c. Don't know
15.	Special software is required to view CBCT images?		
	a. Yes	b. No	c. Don't know

endodontic treatment planning (Figure 4).

The results of the present study showed that although 50.4% of the practitioners were aware of simulated implant placement on CBCT images, only 24.4% of the participants had used it in their practice. Out of the participants who used simulation, 51.6% had depended on the maxillofacial radiologist for the implant site assessment and planning. The awareness of the participants regarding basic knowledge about CBCT was variable. While 80.3% and 74% knew that CBCT required specialized software to analyse the images and that CBCT caused lesser radiation exposure than CT, respectively; it was also noted that a low 26.8% and 38.6% knew that orthopantomo-graph requires lesser image acquisition time than CBCT and a lesser radiation exposure, respectively (Figure 5).
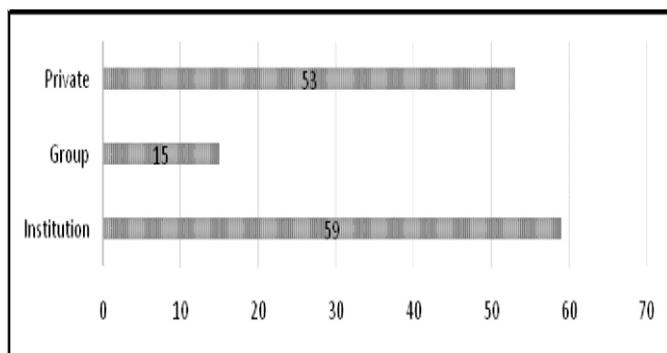

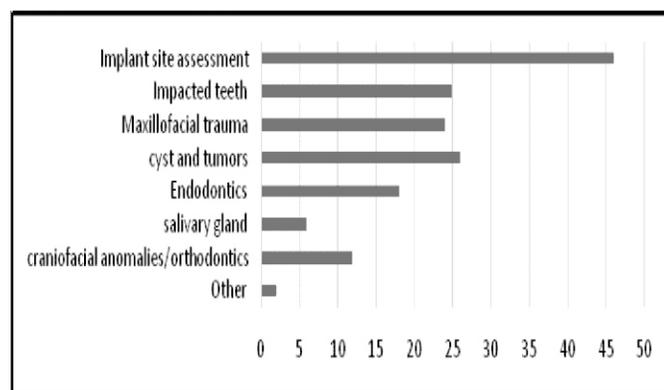**Figure 1: Distribution of participants into various types of dental practice.**

Figure 2: Distribution of clinical application of CBCT by the participants.

DISCUSSION

The use of CBCT in the field of dentistry is growing due to its efficacy in a variety of diagnostic purposes.[9] The awareness about CBCT as a useful diagnostic tool among dental professionals in the present study was 96.1%,
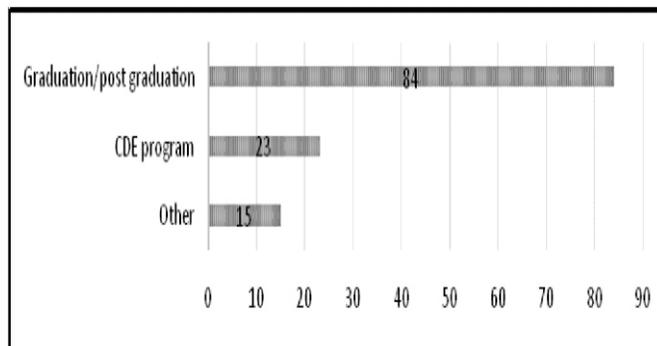

Figure 3: Distribution of participants based on their method of gaining knowledge on CBCT.
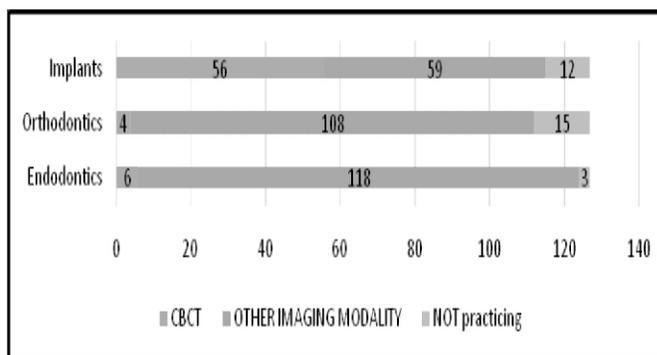

Figure 4: Preference of radiographs by the participants for various dental procedures.
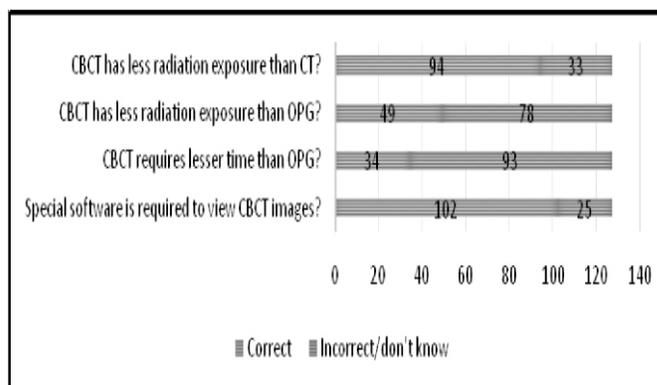

Figure 5: Assessment of basic knowledge amongst the participants about CBCT.

which is in accordance with the study conducted by Balabaskaran and Srinivasan[13] (82% awareness) and Shah and Venkatesh[14] (100% awareness). On the contrary, studies by Reddy RS et al[15], Aditya A et al[16], and Bhagat BA et al[17] indicated poor awareness about CBCT and cited low availability of the technique as one of the major factors for this drawback.

Use of CBCT in various dental fields has been widely advocated. Scarfe et al[18] discussed the clinical applications

of CBCT in dental practice. In the present study, quite a few participants reported the use of CBCT for more than one clinical application in their dental practice. The most common application of CBCT by the participants was for pre-treatment evaluation for implants (70.8%), followed by evaluation of cyst and tumors (40%), impacted teeth (38.5%), and traumatic injuries (36.9%), while only 27.7% used CBCT for endodontic purposes. Similar results were obtained by Balabaskaran and Srinivasan[13], Shetty et al[19], Bhagat et al[17], and Qirresh et al[20]. An inconclusive observation/result was reported by a pilot study conducted by Roshene et al.[21] Although maximum percentage of both final year dental students and interns in their study prescribed CBCT for implants, followed by cyst/tumors, and orthodontic reasons by final year and interns, respectively, however, their study had not evaluated if CBCT was advised for endodontic reasons.

A large number of respondents (68.8%) in this study had attained their knowledge about CBCT during their undergraduate or postgraduate training followed by means of CDE programs (18.9%). Imbibing information about CBCT from other sources like internet and peers was true for 12.3% of the participants. These findings concur with the findings reported by Balabaskaran and Srinivasan.[13] They reported that in their study 48% attained knowledge through lectures, 12% via internet, 9.7% through scientific journals, and 17% by attending seminars. Reddy et al[15] observed that 26.7% of their participants had learned about CBCT at seminars. Participants in the study conducted by Bhagat et al[17] had learned about CBCT at seminars (47%), through internet (20%), and from senior colleagues (10%). There are differences in depth, extent, and structure within the maxillofacial radiology curriculum for undergraduate dentistry. The undergraduate curriculum has changed little over time. In actuality, the dental practitioners would have received insufficient or no training in interpreting CBCT images based on their time of graduation.

The lower rate to use CBCT as a preferred diagnostic imaging modality could be attributed to the fact that most practitioners appreciate the need of a prior training in CBCT to incorporate it in their daily practice. Eighty seven percent of our participants also felt the need for special training prior to the use of CBCT. Aditya et al[16] in their study also observed that the dental specialist were of the opinion that there is a general need for a detailed and formal training in CBCT.

Silva et al[22] used CBCT to detect operative errors in endodontic procedures and dental implants, necessitating the use of the CBCT in post-operative assessment/ complications. Results of the present study, however indicated that CBCT remained the least preferred choice of radiographic modality for endodontic treatment as well as orthodontic treatment planning. Intraoral periapical radiographic was preferred by 95.2% of our participants during their endodontic practice compared to a mere 4.8% using CBCT.

Diagnosis of impacted teeth and assessment of severely malposed tooth requires a thorough understanding of regional radiographic sectional anatomy. However, performing cephalometrics on CBCT requires additional training. Only 3.6% of the participants delivering orthodontic therapy in their practice used CBCT for planning such treatment, as most (96.4%) relied on lateral cephalogram. This is quite in contrast with the study assessing the knowledge of CBCT among orthodontists in Turkey conducted by Cesur et al[23] where in 56.3% participants used CBCT during orthodontic diagnosis. It may be attributed to the different levels of training that dentists specialize in other than maxillofacial radiology in their respective national dental curriculum.

The reliability of using CBCT to select the implant length was assessed by Mello et al[24] in 97 implants done on 27 patients and it was concluded that CBCT helped reduce inaccuracy in implant placement, consequently an important aid in treatment planning. Jacobs et al[25] supported and justified the use of CBCT for oral implant procedure. In the present study, OPG was used by 51.3% of the participants who practiced implant dentistry and CBCT by 48.7% for implant site assessment. This relatively higher preference rate could be because the curriculum of implant dentistry incorporates justification and interpretation of CBCT images.

It is imperative to note that 50.4% of respondents were aware of the role of CBCT in simulated implant placement but only 24.4% had actually used the latter in their clinical practice. Out of the participants using implant simulation, 51.6% depended on the maxillofacial radiologist to perform these simulations, indicating the inefficiency of the users in clinical application of CBCT multiplanar images. Although implant site assessment on CBCT primarily requires understanding of the regional radiographic anatomy, carrying out implant simulation

requires added training. A trained maxillofacial radiologist also requires an understanding of the principle of implant placement to assist the practitioners in implant placement. Several studies have reported the significance of use of CBCT based implant simulations. Worthington et al[26] critically analysed the role of CBCT in planning implants and concluded that virtual planning via implant simulations helped clinicians to envision the end results. The systematic review of CBCT in implant dentistry by Bornstein et al[27] underscored the computer assisted treatment planning. The American Academy of Oral and Maxillofacial Radiology (AAOMR) in an executive opinion statement recommended that dentists who use CBCT in their practices must have a thorough knowledge of head and neck anatomy radiographically, as well as the ability to recognize normal variants and disease. Consequently, the new tendency of teaching CBCT in oral radiology courses should acquaint students with three-dimensional anatomy and prepare them to interpret and investigate these scans during their dental work.[12]

Questions 12-15 in the present questionnaire focused on assessing the knowledge about CBCT. The response to the posed questions by the respondents in this study illustrated the lack of fundamental knowledge of CBCT. This may be explained by the difference in the baseline training as well as experience in this field amongst the participants. The European Association of Dento Maxillofacial Radiology (EADMFR) in their position paper have recommended guidelines for course content for training the dentists who are not specialized in dentomaxillofacial radiology, to use CBCT in their practices.[28] Several similar studies reported in literature aimed at evaluating the knowledge and attitude of dental practitioners towards the use of CBCT have also yielded similar results.[13,14,25,29,30]

The limited use of CBCT imaging modality as observed in this study could be attributed to the limited availability of the CBCT facility in the region as well as its cost. The following recommendations are suggested to improve the present scenario:

- Dental professionals can inculcate CBCT in their practice to aid in proper diagnosis and treatment plan with extended support from the expertise of maxillofacial Radiologist.

- Raise the platform of education and incorporate CBCT as part of the dental education in all clinical dental specialities so as to acquaint students with the three dimensional anatomy. This will prepare them to optimally utilize this imaging modality during their professional career.

CONCLUSION

Even though CBCT presents as an emerging and promising imaging modality for better diagnosis and treatment planning, a gap in knowledge about the same was found amongst dental professionals. This study emphasizes the positive attitude of dentists towards CBCT. Introduction of CBCT machines into the curriculum and hence to the dental teaching institutions would not only make the practitioners better trained for the optimum use of this imaging modality but also will make it more easily available and affordable to the dental patients.

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