

ROLE OF CONE BEAM COMPUTED TOMOGRAPHY IN GENERAL DENTAL PRACTICE- A CROSS SECTIONAL STUDY

Dr. Praveena Raman

Senior Lecturer, Department of Oral Medicine and Radiology, Sathyabama Dental College and Hospital, Chennai

Keywords: Cone beam computed tomography, dental education, knowledge, attitude, radiology, cross sectional imaging, questionnaire, radiation, utility, versatility

Abstract

Aim and objectives: To determine the role of Cone Beam Computed Tomography in general dental practice and to study the response of the general dental practitioners regarding the utility and versatility of CBCT.

Methodology: Following a pilot study, a self-structured questionnaire comprising of 20 questions was given to 200 general dental practitioners in Chennai. Each questionnaire was collected in a ballot box and was individually evaluated.

Statistical analysis: Cronbach's alpha coefficient, T test and Chi-Square were performed.

Results: Males were predominant within the age group of 20-30yrs with >5yrs of experience. 57.5% of dental practice belongs to middle class, followed by 23.5% and 19% in upper class and lower class group respectively. On asking for request for CBCT, 58.5% participants request for a CBCT in their practice and among them 23% request for implants and impactions cases. 42% of dentists have difficulty in interpreting a CBCT image. 33% of the participants agreed that CBCT gives 3D reconstructive images and has got excellent hard tissue resolution, hence very accurate and reliable in dental diagnosis. 79% of the participants have not attended any training programs on CBCT. 100% of the participants were willing to update their knowledge, attend seminars and workshops on CBCT if provided with opportunities.

Conclusion: In the present study, majority of the participants believed that CBCT is a useful diagnostic tool in dentistry and research. Regular continuing education programs, workshops, meetings and seminars are required to update dentists' knowledge on CBCT.

Introduction

Cone beam computed tomography (CBCT) is a 3D imaging modality that has recently become very useful for dent maxillofacial imaging. On comparing with the conventional CT, CBCT units are cost effective, requires less space, have rapid scan time, can limit the beam to head and neck region, reduced radiation, have interactive display modes and multiplanar reformation, making them more suitable for use in dental practices. (1,2) Drawbacks of CBCT includes beam hardening, artifacts from dental materials and very poor soft-tissue resolution.(2)

CBCT is so versatile that it has its own indications in almost all the specialities of dentistry which includes, evaluation of dental caries and periodontitis, examination of teeth and facial structures for orthodontic treatment planning, angulation and orientation of third molar in three orthogonal planes (axial, sagittal, coronal), evaluation of the proximity of mandibular third molar teeth to the mandibular canal prior to extraction, evaluation of osseous degenerative changes of TMJ, evaluation of teeth and bone for signs of fractures, infection, cysts and tumours, and of course emerging into the field of dental implants.(3)

It is also a cause for concern that there is absolutely no literature of any sort reported from the Indian sub-continent where thousands of implants and impactions are being done every year, regarding the utility of CBCT in general dental practice. Hence we thought it is prudent to conduct a survey to gauge the role of CBCT in general dental practice and also regarding its utility and versatility.

Methodology

The study was designed at the department of Oral Medicine and Radiology, SRM dental college, Ramapuram, Chennai and was approved by the Institutional ethical committee board. Initially a pilot survey was conducted with three questions and was distributed to 30 practicing dentist's in Chennai, which included an awareness question on CBCT, to expand CBCT and how did they come to know about CBCT. Based on the responses, the questionnaire was further elaborated by the study investigator. Sample size was calculated with 95% confidence interval and an error rate of +/-5% determining the need to include 200 participants in the study. Only BDS doctors practising in Chennai were included in the study. MDS doctors, dentist's attached to study institutions and participants those who were not willing to participate were excluded from the study. A self-structured questionnaire of 20 questions was prepared using model questions from the literature. (Figure 1)

ROLE OF CONE BEAM COMPUTED TOMOGRAPHY IN GENERAL DENTAL PRACTICE

Qualification: BDS/ MDS Practicing experience: Age/sex:

- Patients in your practice **Predominantly** belongs to? (choose any one)
 - Lower socioeconomic group
 - Middle
 - Higher socioeconomic group
- Do you request for **CBCT** in your dental practice? a)Yes b)No
- If yes, when do you request for **CBCT**? (Multiple choice answering allowed)

- Impactions	- Periodontal problems
- Orthodontic treatments	- TMJ's
- Endodontic treatments	- Trauma
- Implants	- Cysts and tumors
- All of the above	- Specify if any other:
- Please specify the reasons for not using **CBCT**.
 - Expensive for the patient
 - Because of difficulty in interpreting the images
 - Facility is not available in close proximity to practice
 - Satisfied with conventional imaging modalities
- On an average how many **CBCT**'s you request per month? _____
- Does your clinic consultants advise for **CBCT**? a)Yes b)No
- If yes, please specify the specialties: _____
- Does your patients accept for **CBCT** once it is explained? a)Yes b)No
- Do you specify the region of interest while advising for **CBCT**? a)Yes b)No
- What is your opinion on accuracy and reliability of **CBCT**?
 - Excellent hard tissue resolution
 - 3D imaging
 - both a and b
 - conventional imaging modalities is best
- Why do you prefer **CBCT** over the conventional methods?
 - 3D imaging
 - Easy to store data
 - Both a and b
- Why do you prefer **CBCT** rather than medical **CT**?
 - Enhanced diagnosis at a low radiation dose
 - Patient affordability
 - Easy to interpret than CT
 - Data reconstruction can be performed on a personal computer
 - All of the above
 - If any other- please specify:
- Does your **CBCT** accompanied with a report? a)Yes b)No
- Is the given **CBCT** report sufficient for diagnostic and operating procedures? a)Yes b)No
- Do you entirely rely on the **CBCT** report? a)Yes b)No
- What is your opinion on the cost of advising **CBCT**?
 - Very costly
 - Reasonably cost
 - Low cost
- To what extent do you think **CBCT** will be useful in routine dental practice in the near future?
 - In all the areas of dentistry
 - For selected dental applications only - kindly specify: _____
 - It will not be commonly used in routine practice
- What do you feel is the most versatile about **CBCT**? (Multiple choice answering allowed)

- Low radiation dose	- Patient acceptability
- Patient affordability	- 3D imaging
- All of the above	- Specify if any _____
- Have you undergone any training in **CBCT**? a)Yes b)No
- Are you willing to attend any training in **CBCT**? a)Yes b)No

Figure 1

It was then sealed in a cover and given to 200 practicing BDS dentists in Chennai and were given 20 minutes of sufficient time to fill up individually in the absence of the investigator. Each answered questionnaire was again sealed and collected by the study investigator in a ballot box. Participants were not aware of the number of questionnaires already present in the box. After compiling the responses, data was subjected to statistical analysis using SPSS software.

Statistical analysis

Cronbach's alpha coefficient was performed to assess the reliability of the questionnaire. The internal consistency was found out to be 0.889, inferring Good – Excellent reliability. T test was used to compare the means and Chi square test was performed for association between the variables

Results

Among the 30 dental practitioners in the pilot survey, 94% of them were aware of Cone beam computed tomography. Out of the 94%, 34% of the participants came to know about CBCT from their undergraduate lecture classes, 13% were aware after attending seminars, 5% through trauma case referrals, 19% from dental trade fair/expo conducted every year and 23% came to know through their respective dental specialists visiting their clinic.

In the present study, the gender predominance, percentage of participants in different age group (years) and percentage of participants with their experience (years) are illustrated in Fig 2,3 and 4 respectively.

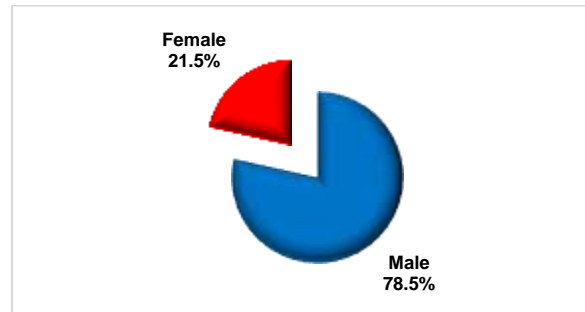


Figure 2

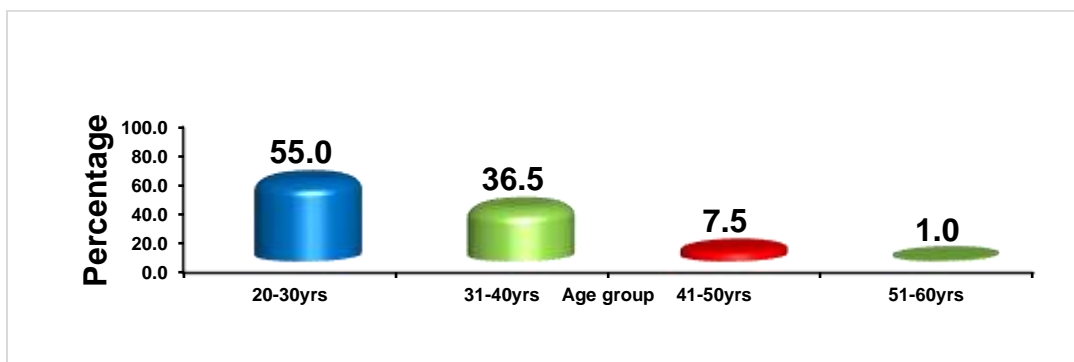


Figure 3

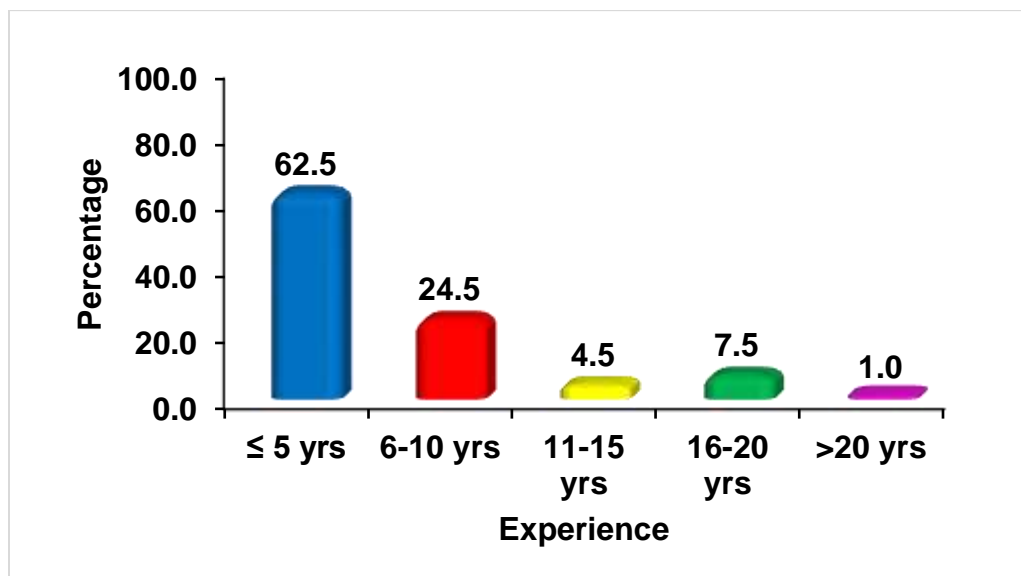


Figure 4

On asking for the predominant patient group in their respective practices, 57.5% belonged to middle class, followed by 23.5% and 19% in upper class and lower class group respectively. On asking for request for CBCT, 58.5% participants answered yes and 41.5% participants answered no; and among the positive response, requesting CBCT for implants and impactions were the highest, both approximately accounting for 23%. The various responses for not prescribing CBCT included, non-availability of the facility at the close proximity, satisfying with the conventional imaging modality, difficulty in interpreting the images and cost, accounting for 17%, 39%, 42% and 2% respectively. 33% of the participants agreed that CBCT gives 3D reconstructive images and has got excellent hard tissue resolution, hence very accurate and reliable in dental diagnosis. 30% of the participants believed that images of CBCT were easy to store and interpret than that of CT. The following were the responses regarding the future of CBCT; in all areas of dentistry, for selected dental applications only and CBCT will not be commonly used in routine dental practice, each accounting for 42.5%, 33.5% and 13.5% respectively. 79% of the participants have not attended any training programs on CBCT. 100% of the participants were willing to update their knowledge, attend seminars and workshops on CBCT if provided with opportunities.

Discussion

In the past, there were several studies focussing on dental practitioner's knowledge about dental radiology digital systems and radiation protection. (3-6) The literature includes one study that evaluates the effectiveness of web-based instructions in the interpretation of anatomy using CBCT images. (7) Little information appears in the literature regarding dental practitioner's knowledge and attitudes about CBCT.

The present study used a questionnaire to gauge the level of knowledge, utility and versatility of CBCT among general dental practitioners. The questionnaire was developed with the guidance from previous studies. (8,9) Our study is first of its kind in the Indian subcontinent, starting from the sample size determination; simple random sampling of general dental practitioners, a questionnaire was used and not a proforma to reduce the bias; as the proforma ease more communication between the study investigator and the study participant, single page of 20 questions, with validation of the questionnaire to determine the internal consistency and appropriate statistical analysis of the data obtained. In this context, this study is an important addition to the existing literature.

Conventional imaging like a panoramic view (OPG), provides an excellent general overview of the dentition and the jaws at a low cost and dose while compared to the cross sectional imaging and it is available widely. But, they have certain inherent limitations like distortions in the horizontal plane, magnification in the vertical plane, two

dimensional representation of a three dimensional entity, important anatomical structures like the Inferior alveolar canal being not well appreciated, superimposition of images closer to the lingual cortex at a higher level, the numerous airway shadows, ghost images and soft tissue shadows, all of which can adversely affect treatment planning. (10)

All the practitioners in our study have mentioned cost with other factors like radiation dose, non-availability at the close proximity and difficulty in interpreting the images. The costs involved in cross-sectional imaging may add burden causing practitioner's to forego cross-sectional imaging techniques and rely more on their clinical acumen and expertise. According to the study by Sakakura et al, 3 dentist's (1%) considered radiation dose to influence their prescription (11). CBCT scanning delivers an effective dose approximately 50 to 100 times less than the radiation dose delivered during conventional CT. (12) All radiographic imaging must be dealt with exposure to x ray radiation "as low as reasonably achievable" (ALARA), to avoid unwanted complication and maximize treatment outcomes. But, definitely the lowest dose possible should not be achieved at the cost of poor diagnostic information. This would also lead to practitioners requesting a repeat radiographic examination increasing the cumulative irradiation to the patient. Hence, the non-availability of the cross sectional imaging modality, coupled with the dentist's familiarity with assessment of an OPG image and lack of knowledge about cross-sectional imaging and its cost , may all be the factors contributing to the poor utility of cross sectional imaging.

In India similar to other countries the interpretation of CBCT images is done by specialist oral and maxillofacial radiologist who also specialises in oral medicine. These specialists are few in number and the general dentist is not trained to interpret cross-sectional images which maybe a cause for the reduced number of referrals. Small changes in the dental education curriculum can change all that. This is already being implemented in the curriculum prescribed by the Dental Council of India where maxillofacial radiology is being taught at the undergraduate level itself. In our study, 23% of the practitioners prescribe CBCT for implant cases. The use of CBCT in implant imaging seems to be very promising however there is a need for more research on the efficacy of CBCT in assessment of the implant site. Currently there has not been any large scale standardised trials involving CBCT use and implant success or failure anywhere in literature and would be a good avenue to direct further research. Our study has shown similar results as that of Beason and Brooks Sakakura et.al, McCrea and Shelley et.al where the majority of the dentists are satisfied with the conventional imaging modality- OPG based on broad coverage, cost and availability. (11,13,14) 100% of our participants felt CBCT is a useful diagnostic tool in dentistry and are willing to attend seminars and other related programs to update their knowledge on cross sectional imaging if provided with opportunities which was similar to the study by Balabaskaran K et al (15).

We feel there is a need to develop a broad evidence based criteria for radiographic prescription and this has to be introduced in the current dental school curriculum throughout the world. For this to be possible, data from different regions of the world regarding awareness and utility practices must be collated and all the professional bodies located around the world, have to collaborate to put forward a consensus paper establishing guidelines for radiographic prescription.

Theoretical lessons on CBCT have only recently been included in the dental school curriculum. Considering the fact that there are less than 30 CBCT units available throughout Chennai, it is not surprising that CBCT education remains limited to theoretical instruction (by comparison, 3000 CBCT units have been purchased in the USA and 800 in Germany).(16) Our study highlights the difficulties of acquiring knowledge about a system without practical experience. The lack of CBCT units at institutions seems to have played a significant role in the awareness.

Conclusion

CBCT is one of the most significant new developments in modern dentistry. It has an important role in the diagnosis of oral and maxillofacial pathologies with reduction in radiation dose. This study focussed on the awareness, versatility and utility of cone beam computed beam tomography in general dental practitioners in Chennai. Thus by creating awareness and imparting knowledge to new clinicians about the use of advanced imaging modalities, it will be highly possible to improve the quality of treatment delivered to the patient. There is an urgent need to organize regular continuing education programmes, post graduate education courses, meetings and seminars to update

dentists' knowledge about CBCT and it should be included into dental radiology curriculum with sufficient practical experience. Dental practitioners should prescribe CBCT imaging only when they expect that diagnostic yield will benefit patient care, enhance patient safety or improve clinical outcomes significantly.

References

1. Scarfe WC, Farman AG, Sukovic P. Clinical applications of cone-beam computed tomography in dental practice. *J Can Dent Assoc* 2006; 72: 75–80.
2. Scarfe WC, Farman AG. What is cone-beam CT and how does it work? *Dent Clin North Am* 2008; 52: 707–730.
3. Wenzel A, Moystad A. Experience of Norwegian general dental practitioners with solid state and storage phosphor detectors. *Dentomaxillofac Radiol*. 2001; 30: 203-208.
4. Aps JK. Flemish general dental practitioners' knowledge of dental radiology. *Dentomaxillofac Radiol*. 2010; 39: 113-118.
5. Jacobs R, Vanderstappen M, Bogaerts R, Gijbels F. Attitude of the Belgian dentist population towards radiation protection. *Dentomaxillofac Radiol*. 2004; 33: 334-339.
6. Davies C, Grange S, Trevor MM. Radiation protection practices and related continuing professional education in dental radiography: A survey of practitioners in the North east of England. *Radiography*. 2005; 11: 255-261.
7. Al-Rawi WT, Jacobs R, Hassan BA, Sanderink G, Scarfe WC. Evaluation of web-based instruction for anatomical interpretation in maxillofacial cone beam computed tomography. *Dentomaxillofac Radiol* 2007; 36: 459–464.
8. Ilgüy D, Ilguy M, Dincer S, Bayirli G. Survey of dental radiological practice in Turkey. *Dentomaxillofac Radiol*. 2005; 34: 222-227.
9. Wenzel A, Kirkevang LL. Students' attitudes to digital radiography and measurement accuracy of two digital systems in connection with root canal treatment. *Eur J Dent Educ*. 2004; 8: 167-171.
10. Theory of rotational panoramic radiography. In: Welander U, Tronje G, McDavid WD, DelBalso AM, Langlais RP, Langland OE (Editors) *Panoramic Radiology* (2nd edn) Philadelphia: Lea & Febiger. 1989; pp. 38-40.
11. Sakakura CE, Morais JA, Loffredo LC, Scaf G. A survey of radiographic prescription in dental implant assessment. *Dentomaxillofac Radiology*. 2003; 32: 397-400.
12. Ludlow JB, Davies- Ludlow LE, Brools SL: Dosimetry of two extra oral direct digital imaging devices: New to me cone beam CT and orthophos plus D panoramic unit, *Dentomaxillofac Radiol* 32:290,2003.
13. Beason RC, Brooks SL. Preoperative implant site assessment in southeast Michigan. *Journal of Dental Research*. 2001; 80: 137.
14. Shelley AM, Wardle L, Goodwin M, Brunton P, Horner K. A questionnaire study to investigate custom and practice of imaging methods for the anterior region of the mandible prior to dental implant placement. *Dentomaxillofac Radiology*. 2013; 42: 2-11.
15. Balabaskaran k, Arathy Srinivasan L. Awareness and Attitude among Dental Professional towards CBCT. *IOSR-JDMS*. 2013; 55-59.
16. Farman AG. Self-referral: an ethical concern with respect to multidimensional imaging in dentistry? *J Appl Oral Sci* 2009; 17.