

Knowledge, Awareness and Applications of 3D Imaging among sub-urban Dentists in South India -A Questionnaire Study

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Abstract

CBCT has revolutionized maxillofacial imaging as it can produce up to 600 thin slice images in a rapid scan time and all of the images can be enhanced with interactive display modes. However, despite being such a crucial development, there has been considerable delay in the actual reach of this modality to dental practitioners spread across the world. The present study aims to assess the knowledge, attitude, and perspective of the general dentists towards the use of CBCT in a sub-urban south Indian population. The present study was conducted among a convenient sample comprising of general dentists, specialists in and around the sub-urban Kanchipuram district, Tamil Nadu. The dentists were selected by convenient sampling and each of them was given a 11-item questionnaire regarding their knowledge and attitude towards use of cbct in their daily practice. SPSS package 20.0 was used for the statistical analysis. 62% regularly used various 2D and 3D imaging techniques in their routine dental practice. 36% used imaging techniques occasionally and 2% never used imaging techniques in their everyday practice. A majority of 96% have heard of the applications of CBCT in dentistry whereas 4% of the participants were not aware of its application. 43% of dentists in our study relied on an oral medicine and radiology expert for interpretation of CBCT images whereas 31% relied on the radiologist's report. The applications of this 3D imaging modality have to be further educated among the sub-urban dentists and more accessibility and availability has to be promised. Key-words: Cone beam computed tomography, 3d imaging, sub-urban dentists

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1. Introduction

In the past one hundred years of dentistry, dental research has made a tremendous impact through numerous dental innovations and their applications have been pivotal in providing standard oral care to the masses. One such remarkable innovation is the cone-beam computed tomography (CBCT) introduced in 1996 in the European market by QR SRL (New Tom 9000) [1]. CBCT has revolutionized maxillofacial imaging as it can produce up to 600 thin slice images in a rapid scan time and all of the images can be enhanced with interactive display modes. However, despite being such a crucial development, there has been considerable delay in the actual reach of this modality to dental practitioners spread across the world. Lack of availability across suburban and rural areas, lack of adequate knowledge and training has caused the world of 3D imaging yet remain a challenge among parts of the dental community.

The present study aims to assess the knowledge, attitude, and perspective of the general dentists towards the use of CBCT in a sub-urban south Indian population.

2. Materials and methods

The present study was conducted among a convenient sample comprising of general dentists, specialists from various disciplines, faculties of few teaching institutions, postgraduates pursuing various dental specialties, and private practitioners in and around the sub-urban Kanchipuram district, Tamil Nadu. The study protocol was approved by our Institutional ethical committee. A total of 100 dentists participated in the study. We used a structured, close-ended 11-item questionnaire that was validated by a team of faculties from the department of oral medicine and radiology. It was later administered to the participants. The questionnaire consisted of baseline information such as age, sex, highest qualification, and years of employment. Questions 1, 2, 3, and 4 evaluated the awareness and use of CBCT in daily practice. Question 5, 6,

and 11 assessed the knowledge of CBCT including the principle of CBCT, the terminologies commonly used in a CBCT image interpretation, and the source of knowledge regarding this imaging modality. Question 7 comprised of 7 indications for the use of CBCT and was of multi-choice format. Question 8 was about the interpretation of CBCT images. Question 9 was regarding the various brands of CBCT machines. Question 10 considered the reasons for not using CBCT routinely.

To observe the differences between various categorical values in our data, a chi-square test was applied. The correlation between groups was evaluated with the Pearson correlation test. A P value of less than 0.05, it was considered significant. SPSS package 20.0 was used for the statistical analysis.

3. Results and Discussions

All the 100 questionnaires included in the study were completely filled by the participants. The baseline information obtained was as follows: 45% were in the middle age group of 31 to 50 years, 47% were in the younger age group of 21 to 30 years and 8% were in the older age group of above 51 years. 69% of the participants were male and 31% of the participants were female. Regarding the qualification, 58% had completed BDS and were general practitioners, 31% had completed their post-graduation and were either faculties or private practitioners and 11% were pursuing their post-graduation course. The participants comprised of 58% general dentists, 8% orthodontists, 6% prosthodontists, 6% endodontists, 5% oral pathologists, 5% oral medicine and radiology specialists, 4% oral and maxillofacial surgeons, 4% periodontists and 3% pedodontists. A total of 76% had an experience of 1 to 5 years, 16% had an experience of 6 to 10 years, 5% had an experience of 11 to 15 years, 2% had an experience of 16 to 20 years and 1% had an experience of 21 to 25 years. The data was evaluated qualification-wise, specialty wise and correlated with the years of experience. Among the 100 participants, 62% regularly used various 2D and 3D imaging techniques in their routine dental practice. 36% used imaging techniques occasionally and 2% never used imaging techniques in their everyday practice (Fig 1).

Routine radiographical examination in dental practice includes panoramic imaging, AP, lateral skull and three-dimensional imaging techniques like multi-slice computed tomography and CBCT [2]. In the present study, 62% used conventional intraoral periapical radiograph (IOPA) only, 11% used an RVG only, 9% employed OPG only, 2% used IOPA and RVG, 8% used IOPA and OPG, 4% used RVG and OPG, 3% used IOPA, RVG and OPG. Only 1% used imaging modalities other than 2D imaging, routinely. Our results (Fig 2) were contrary to those obtained in earlier studies where the majority of dentists preferred digital imaging and only a small percentage preferred conventional radiography [3, 4]. The users of RVG were also quite few in our study (11%) which brings to light the gap between dental innovations and the actual acceptance of the digital era. There was no correlation between the imaging preferences documented and the

specialty of the participants. A Scatter plot was done for the years of experience and the imaging modalities routinely used and this had a significant correlation. ($p=0.030$) (Table 2). A majority of 96% have heard of the applications of CBCT in dentistry whereas 4% of the participants were not aware of its application in the field of dentistry.

These findings were contradictory to a study done in 2015 where a low level of awareness about CBCT among dental practitioners was documented [5]. This also highlights the digital revolution that has kick-started in the past 5 years with more dentists switching to the latest dental innovations. 45% have used CBCT for the diagnostic purpose at least once in their practice whereas 55% of the participants had never used CBCT in their dental practice. Among the general dentists, 22.4% have used CBCT at least once in their dental practice and 77.62% have never used it even once. 50% of the specialty dentists have used CBCT at least once in their practice whereas 50% have never used CBCT ever. Our study shows the lack of usage among the majority of the general practitioners and even among the various specialists, the actual usage levels are alarmingly less. Generally, the awareness levels regarding the existence of 3D imaging modality have improved massively yet the application aspect of it remains a question. Our results were non-homogenous with studies done earlier on the use of CBCT among dentists where extensive usage was documented [6]. The reason for this difference could be the fact that our study was implemented among dentists in a sub-urban setup where accessibility and availability have remained a challenge.

CBCT is based on the principle of tomo-synthesis wherein a 2D digital array provides an area detector that is combined with a 3D x-ray beam with an attached circular collimation such that the resultant beam is cone-shaped [7]. In our study, 83% of the dentists identified cone-shaped beam as the principle of CBCT. However, 3% considered the principle as an elliptical beam, 1% as a fan-shaped beam, and 13% as a rotational beam. Out of the general practitioners, 86.2% marked cone beam, 1.7% marked as an elliptical beam, 1.7% marked as fan beam, and 10.3% considered the principle of CBCT to be a 360-degree rotational beam. Among the specialists, 78.6% answered as cone beam, 4.8% as elliptical, and 16.7% as 360-degree rotational beam. This question brings to light the lack of basic theoretical knowledge that is most needed while operating and using an innovation of this magnitude. (Table 1) Concerning the years of experience, 76% of dentists with an experience of above 5 years had given the right answer (cone beam) and 24% had selected other options like the rotational beam. Although the knowledge levels were higher among the experienced practitioners, there was no significant correlation between the years of experience and the knowledge levels ($p=0.056$). This was similar to results obtained by Abdelmoniam et al where no correlation was found between the age of the practitioner, years of experience, and their knowledge levels regarding CBCT [8]. An exciting aspect of CBCT is the user-friendly software that allows for various options that enable the user to extract the desired images according to the thickness needed by peeling away layers of the captured anatomy. The users can extract planar or curved reconstructions in

different orientations. True 3D reconstructed images of the tissues can be visualized and their resolutions can be modified and many more options are available through third-party software which enables us to utilize the data effectively [9]. However, for efficient image acquisition, the clinician should be aware of basic terminologies like the field of view (FOV), SSV, MIP, DICOM, multiplanar reconstructions and the various orientations possible etc.,. But in our study, 37% of the participants had never heard of such terminologies and their applications, 58% were partially aware and only 5% were fully aware of such terms. Among the general practitioners, a huge majority of 55.2% had never heard of these terminologies, 43.1% were partially aware and only 1.7% were fully aware of the terms. Among the specialty dentists, 21.43% had never heard of these terminologies, 78.6% were partially aware and only 9.5% were fully aware of them. With regard to the years of experience, only 12% of the dentists with experience of above 5 years were fully aware of the terms, 68% were partially aware and 20% had never heard of them. This indicates the lack of knowledge and the consequent difficulties faced by the clinician while interpreting a CBCT image. The very referral for a 3D imaging modality is lost if the clinician is unable to use the image according to his specific needs. Lack of exposure in the undergraduate curriculum may be a reason for this disparity. Even the various dental specialties fail to incorporate the adequate application of 3D imaging modalities in cases of clinical importance.

When assessed about the indications for which the clinicians preferred CBCT, 3% preferred for trauma cases, 30% for implants, 3% for orthodontic treatment, 10% for impacted teeth, 7% for temporomandibular joint (TMJ) pathologies, 5% for management of cysts and tumours. Only 7% considered use of CBCT for trauma, implants, TMJ pathologies, and for cyst and tumour management. Only 1% of participants preferred use of CBCT for implants, bone loss, impacted teeth, and for cyst and tumour management. Only 2% referred for CBCT for implants, bone loss, impacted teeth, TMJ pathology, and for evacuation of cysts and tumour management. Our results were similar to studies by Dolekoglu et al, Svenson et al where the majority of dental practitioners preferred CBCT for implants followed by TMJ pathologies and management of cyst and tumours [4, 10]. However, the overall awareness regarding the indications was weak in our study. The study population comprised of 31% of specialists and still, only 3% among them preferred CBCT for head and neck trauma and only 1% preferred for bone loss and periodontal evaluation.

There was no significant correlation between the years of experience and the choice of indications. Knowledge for interpretation of CBCT images is vital in providing accurate diagnosis and laying a good treatment plan. Age and years of experience in the dental field are essential factors that influence the confidence of a dentist in the interpretation of images. In the present study, only 26% of the participants were confident at self-interpreting CBCT images. These participants were older and also had an

experience of above ≥ 5 years. In our study, the specialty practitioners were more confident at image interpretation when compared to the general dentists though the correlation was insignificant. ($p=0.051$) The results were, in contrast, to a study done in 2017 in Sweden, in which more than half of the participating dentists (53.6%) were confident at interpreting CBCT images [4].

A total of 43% of dentists in our study relied on an oral medicine and radiology expert for interpretation of CBCT images whereas 31% relied on the radiologist's report. This item highlights the need for an oral radiologist at every advanced imaging centre so that the reports can be properly checked and duly signed by a qualified OMR specialist. Also, further training needs to be given to postgraduates pursuing oral medicine and radiology so that they can enhance their skills in this arena. The results were similar to another study where 100% of the participants had agreed on the need for an oral radiologist in handling CBCT centres and in interpreting the images [6].

A few brands of CBCT machines like iCAT, scanora 3D, Planmeca, newton 3G were mentioned and the participants were asked to identify the familiar ones known to them. Only 3% were aware of iCAT, 22% of scanora 3D, 7% of Planmeca, 4% of newton 3G, and 64% had no idea about any of the brands. (Table 1) This particular item in the questionnaire was administered to assess the levels of reach of the current market scenario to the average sub-urban dentist. With less than five CBCT centres providing imaging services in the sub-urban district of Kanchipuram, Tamil Nadu, it is high time dental professionals launch their own imaging centres which can serve the problem of accessibility in sub-urban areas. In a recent study done in Hong Kong, around 50.4% of dental practitioners owned their own CBCT unit and 70% among them practiced low-dose protocols [11]. This shows that parts of the global dental population have accepted 3D imaging and can provide a rapid and precise oral diagnosis for the masses. Thorough knowledge of the market specifications of popular brands of CBCT can help Indian dentists to decide on a useful investment that will contribute to a sound career. When interrogated about the reason for not using CBCT routinely for cases with appropriate indications, a huge majority of 83% of the participants said that it was expensive. 9% did not use it as their patients were not willing, 2% had no computer knowledge and around 6% had no awareness about its use in the dental field. The results were similar to earlier studies where a vast majority of dentists found CBCT to be expensive [12, 13, 14]. Regarding the source of their knowledge about CBCT, 69% of dentists revealed learning through faculty lessons, 9% from seminars, 16% from CDE programs, and 6% had attended hands-on courses to learn about this 3D imaging modality. These results were similar to the earlier studies wherein the majority of dentists gained knowledge about CBCT from faculty lectures [6, 15, 16, 17].

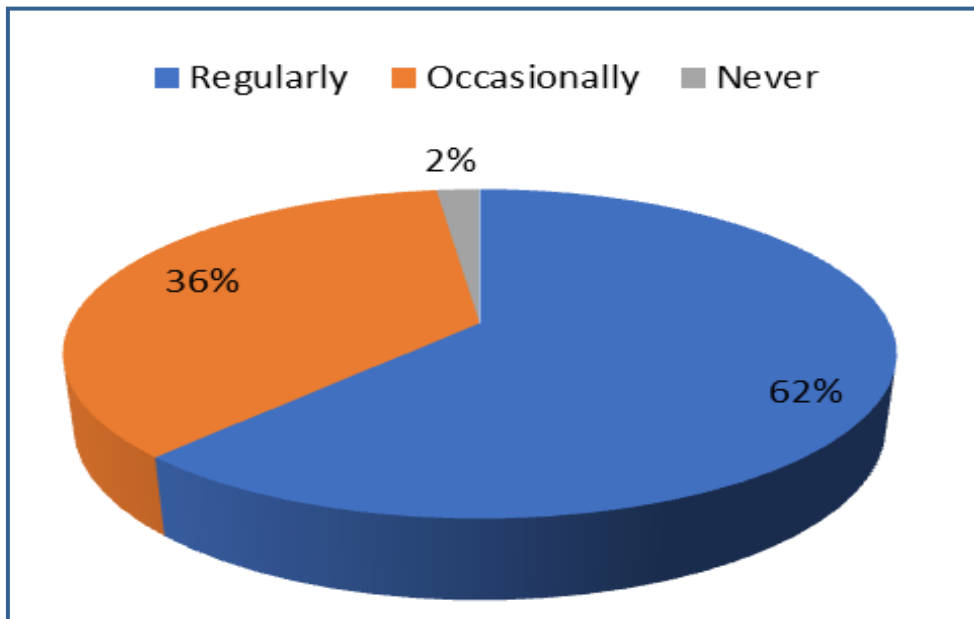


Fig. 1. Usage of CBCT imaging in routine dental practice

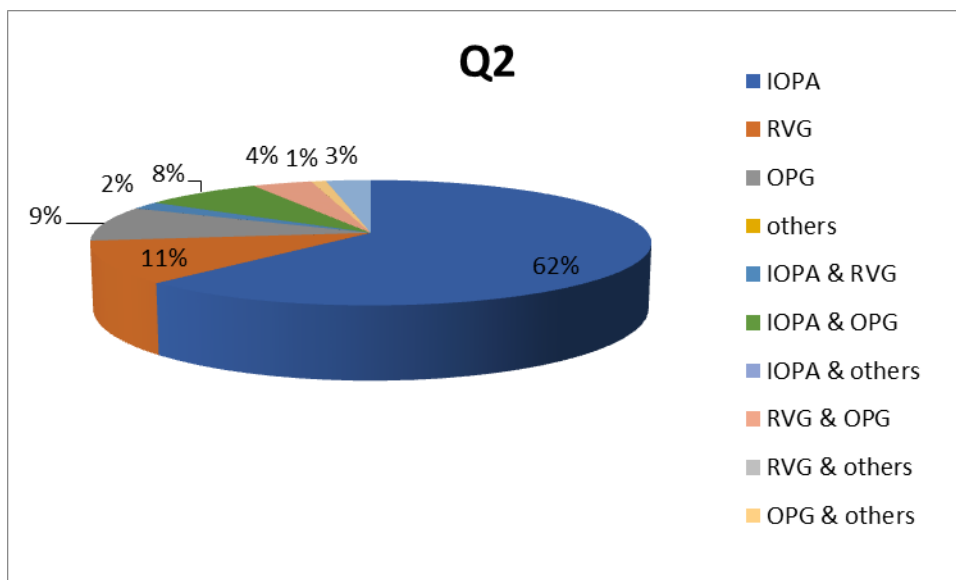


Fig. 2. Imaging modalities used most commonly by sub-urban dentists

Table 1. The Response received for questions on the principle of CBCT and awareness about the brand names of CBCT

What is the basic principle of CBCT?	Frequency	Percent
Cone Beam	83	83%
Fan Beam	03	3%
Elliptical Beam	01	1%
360 Rotational Beam	13	13%
What brands of CBCT have you heard about?		
No idea	64	64%
Planmeca	07	7%
Scanora	22	22%

Table 2. Correlation between years of experience and the preferred imaging modalities in routine dental practice

Q2	Variables	Correlation coefficient (r value)	p value
	Years of experience	0.20	0.030

4. Conclusions

Cone-beam computed tomography has been remarkable to the era of digital dentistry with image quality comparable to multi-slice imaging with low radiation doses. The applications of this 3D imaging modality have to be further educated among the sub-urban dentists and more accessibility, availability, practical sessions, loans to purchase such setups have to be provided. The development of the suburban areas across parts of India has to be considered and the shortcomings of these dental practitioners have to be attended to, such that the urban, suburban, and rural practitioners grow together in this world of digital dentistry.

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