



## Original Research Article

# A questionnaire study on knowledge of digital radiography and CBCT among Indian dentists and dental students

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## Abstract

**Background:** CBCT as well as Digital radiography is being used increasingly in India in the last 20 years.**Aim and Objectives:** The aim of this study is to obtain knowledge about the prevalence of use of digital radiography and cone-beam computed tomography and to comprehend dental students and dental practitioners knowledge about this diagnostic tool and their requirement for awareness about this topic.**Materials and Methods:** Questionnaires consisting of 20 questions were given to the dental practitioners and dental students of different dental colleges in India during the period of March-April, 2024 which included first year to final BDS students, interns, and postgraduate students and practicing dental surgeons. The information was collected from each participant through structured questionnaires regarding attitude and awareness towards usage of CBCT and digital radiograph and radiation protection as well. The Pearson correlation coefficient test was employed to evaluate the validity and reliability of the questionnaire, with a p-value of  $\leq 0.05$  considered statistically significant.**Results:** This study analyses the data obtained from 155 respondents. Most of the clinicians (80.6%) have used digital radiographic methods in their practice. The institutions usually have a digital dental X-ray machine, less often a digital panoramic X-ray machine, and least often a cone-beam computed tomography (CBCT) unit. Most dental practitioners performed 1 to 5 CBCT scans per month for adult patients and the most frequent reason for its use was implant planning (78.1%). Of the practitioners, 70.3% use necessary radiation protection measures in their dental set up.**Conclusions:** The number of digital X-ray machines has increased throughout the last decade. Indian dental professionals do not often use cone-beam computed tomography. Some concerns were raised about respondents' knowledge regarding exposure factors and working principles of CBCT. Additional training programmes should be organised to Indian dental professionals regarding working principles and uses of CBCT.**Keywords:** Cone-beam computed tomography, Digital radiography, Questionnaire, Awareness**Received:** 15-06-2025; **Accepted:** 18-07-2025; **Available Online:** 25-07-2025

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## 1. Introduction

Digital radiography plays a very significant role in diagnosing dental disorders and its use has increased significantly as a new imaging modality over the period of time for its several advantages. Digital radiographic sensors are used in place of conventional films in this modality which provides several advantages like increased image quality for better diagnosis, lower cost and time saving as it eliminates developing process, easier for data storage and sharing with other professionals, decreasing radiation dose which aligns with the ALARA principles.<sup>1</sup> Digital radiography in dentistry mainly consists of Radiovisiographs (RVG), Orthopantomographs and Lateral Cephalograms. Digital radiography has a few disadvantages like infection control of

sensors, difficulty in placing sensors due to sensor bulk, poorer spatial resolution, increased sensitivity to scattered radiation and chances of geometric distortion etc.

To minimize these limitations, three dimensional imaging modalities like Cone Beam Computed Tomography (CBCT) are used. But it should not be used extensively in every cases due to its larger radiation doses. So, ethical consideration and ALARA principle should be kept in mind while ordering a CBCT. Also CBCT parameters should be considered and adjusted according to the need of the patient and the clinician. Radiation dose of CBCT is lesser than conventional CT imaging.<sup>2</sup> CBCT imaging should be used cautiously but it can help to diagnose and then to make a proper treatment plan. The aim of this Questionnaire study

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is (1) to obtain knowledge about the prevalence of use of digital radiography and cone-beam computed tomography and (2) to comprehend dental students and dental practitioners knowledge about this diagnostic tool and their requirement for awareness about this topics.

## 2. Materials and Methods

The study was conducted in Government Dental College and Hospital, Chhatrapati Sambhajinagar, India.

A validated structured questionnaire was adopted under the guidance of previous studies. The related approval was obtained from the Institutional Ethics Committee, GDCH, Chh Sambhajinagar and the study was in accordance with declaration of Helsinki. The knowledge and attitude of total 155 (101 females, 54 males) dental students and dental professionals were surveyed. The study groups consist of 37 BDS students, 49 practicing dental surgeons and 69 postgraduate students (PGs) from all nine specialties of

dentistry. The dentists and dental professionals were informed about the anonymous processing of the questionnaires. The questionnaire consists of 20 questions and was anonymous.

All participants had a questionnaire which consisted of 20 questions (**Table 1**). The questionnaire comprised of different sections. These were: (a) demographic characteristics of dentists (2 questions), (b) Features of respondents such as general practitioner, dental service or UG or PG student (3 questions); (c) digital radiographic system (5 questions) (d) CBCT (8 questions) (e) Radiation protection (2 questions).

Statistical analysis was performed using Pearson correlation coefficient test to know the validity of the questionnaire and any  $P \leq 0.05$  was considered statistically significant.

**Table 1:** Dental imaging questionnaire

Q.No.	Question	Options (Tick ✓ your choice)
1	Age Group (in years)	<input type="checkbox"/> 20–25 <input type="checkbox"/> 26–30 <input type="checkbox"/> 31–40 <input type="checkbox"/> 41–50
2	Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Other
3	Designation	<input type="checkbox"/> 1st–3rd Year UG <input type="checkbox"/> 4th Year to Intern <input type="checkbox"/> Practicing Dentist <input type="checkbox"/> PG – Oral Medicine <input type="checkbox"/> PG – Oral Pathology <input type="checkbox"/> PG – Oral Surgery <input type="checkbox"/> PG – Endodontics <input type="checkbox"/> PG – Prosthodontics <input type="checkbox"/> PG – Periodontics <input type="checkbox"/> PG – Pedodontics <input type="checkbox"/> PG – Orthodontics <input type="checkbox"/> PG – Public Health
4	Practice Setting	<input type="checkbox"/> Dental College <input type="checkbox"/> Govt./Private Hospital <input type="checkbox"/> Private Clinic
5	Use radiographs in practice?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6	Heard about RVG?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Maybe
7	Used RVG?	<input type="checkbox"/> Yes <input type="checkbox"/> No
8	Frequency of RVG use	<input type="checkbox"/> Daily <input type="checkbox"/> Occasionally <input type="checkbox"/> Heard but never used
9	Knowledge of exposure factors	<input type="checkbox"/> Yes <input type="checkbox"/> Use pre-programmed <input type="checkbox"/> Don't know
10	Most commonly used imaging	<input type="checkbox"/> RVG <input type="checkbox"/> Digital OPG <input type="checkbox"/> CBCT <input type="checkbox"/> Others: _____
11	Heard about CBCT?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Maybe
12	CBCT machine in clinic?	<input type="checkbox"/> Yes <input type="checkbox"/> No
13	Used CBCT reports in diagnosis?	<input type="checkbox"/> Yes <input type="checkbox"/> No
14	Aware of CBCT working principle?	<input type="checkbox"/> Yes <input type="checkbox"/> No
15	Need CBCT in workplace?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Maybe
16	Prefer conventional X-rays before CBCT?	<input type="checkbox"/> Yes <input type="checkbox"/> No
17	No. of patients advised CBCT/month	<input type="checkbox"/> 0 <input type="checkbox"/> 1–5 <input type="checkbox"/> 6–10 <input type="checkbox"/> 11–20 <input type="checkbox"/> >20
18	Common reasons for CBCT (Choose 3)	<input type="checkbox"/> Implant <input type="checkbox"/> Cysts/Tumors <input type="checkbox"/> Impacted Teeth <input type="checkbox"/> Oral Cancer <input type="checkbox"/> Missed Canal <input type="checkbox"/> Root Fracture <input type="checkbox"/> Cleft Lip/Palate <input type="checkbox"/> Sinus/Bone Graft <input type="checkbox"/> Periapical Lesions <input type="checkbox"/> Trauma
19	Radiation protection measures used?	<input type="checkbox"/> Yes <input type="checkbox"/> No
20	Is CBCT better than CT for dental use?	<input type="checkbox"/> Yes <input type="checkbox"/> No

### 3. Results

#### 3.1. Demographic statistics

One hundred and fifty five dental students and dental practitioners filled up this questionnaire survey form. The majority of respondents were in the age range of 26 to 30 years (n = 84, 54.2%). Among the 155 respondents in total, 65.2% (n = 101) of respondents were females and 34.8% (n = 54) were males. 31.6% (n= 49) of the respondents were practicing general dental surgeons. The maximum number of respondents perform dental procedures in a public dental institution (dental colleges) (n = 94, 60.6%). Descriptive statistical data of the respondents are presented in **Table 2**.

**Table 2:** Demographics of respondents:

Respondents		N (%)
Age group ( in years)	20-25	65(41.9%)
	26-30	84(54.2%)
	31-40	05(3.2%)
	41-50	01(0.7%)
Gender	Male	54(34.8%)
	Female	101(65.2%)
Specialization	UG student ( 1 <sup>st</sup> - 3 <sup>rd</sup> year)	20(12.9%)
	UG student 4 <sup>th</sup> year- Intern	17(11%)
	Practicing dental surgeon	49(31.6%)
	PG student OMR	27(17.4%)
	PG student Oral Pathology	05(3.2%)
	PG student OMFS	04(2.6%)
	PG student Endodontics	04(2.6%)
	PG student Prosthodontics	11(7.1%)
	PG student Periodontics	05(3.2%)
	PG student Public health dentistry	01(0.6%)
	PG student Pedodontics	07(4.5%)
	PG student Orthodontics	05(3.2%)
You perform dental procedures in	Dental College	94(60.6%)
	Govt./ Pvt Hospital	28(18.1%)
	Private Clinic	33(21.3%)

#### 3.2. Radiologic equipment statistics

Among the 155 respondents, 145 (93.5%) uses dental radiographs as a tool for diagnosis in their dental set up [Table 3]. So both dental students and dental professionals mostly depends on dental radiograph as a diagnostic tool. 139 (89.7%) participants have heard about RVG, 5 (3.2%) are not

so sure, while rest 11 (7.1%) are unaware of this term. Among them 125 (80.6%) have used RVG on dental setup but only 49% use RVG on daily basis in their clinical practice. 54 (34.8%) can provide detailed exposure factor setting of RVG machine used in daily dental practice. Most commonly used dental radiographic modality is RVG 104 (67.1%) and least used modality is CBCT 9 (5.8%)

**Table 3:** Use of dental radiographs in dental set up

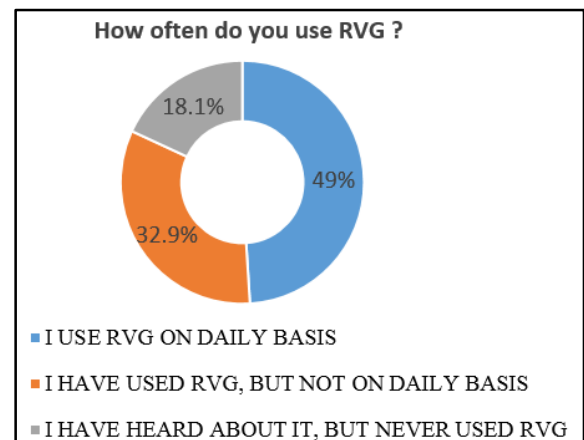
Answer	Use of dental radiographs in dental set up
Yes	93.50%
No	6.50%

**Table 4:** Awareness about RVG

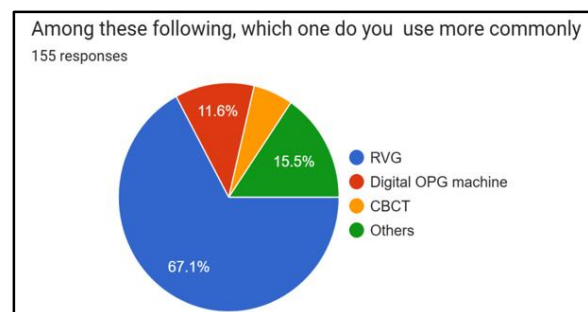
Have you heard about RVG?	Percentage
Yes	89.70%
No	3.20%
May be	7.10%

**Table 5:** Use of RVG in dental Set-up

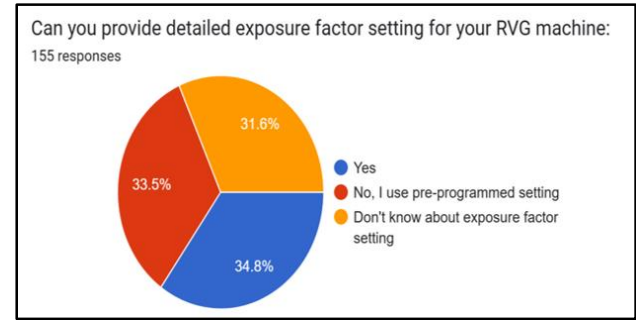
Answer	Use of RVG in dental set-up
Yes	80.60%
No	19.40%



**Figure 1:** Frequency of using RVG



**Figure 2:** Awareness about detailed exposure factor setting of RVG machine



**Figure 3:** Frequency of use between RVG, digital OPG, CBCT, Others

3.3. CBCT knowledge and practice statistics

Among 155 respondents, 144 (92.9%) have heard about CBCT while 114 (73.5%) use CBCT reports for diagnosis or treatment planning but only 61 (39.4%) have CBCT in their clinical set up. It can be inferred from this study that approximately 79% (123) knows about the working principle of CBCT. 107 participants (69%) have felt the need for three-dimensional imaging modalities like CBCT in their routine dental practice.

All dental specialists who participated in the study, among them 21 (13.5%) participants do not prescribe CBCT at all, whereas 65 (41.9%) prescribe 1-5 CBCTs per month on average.

31 (20%) prescribe 6-10 CBCTs per month on average; 20 (12.9%) prescribe 11-20CBCTs per month and only 18 (11.6%) prescribe more than 20 CBCTs per month.

The CBCT was most often performed for implant placement (n = 35, 22.6%), then for diagnosis and evaluation of cysts and tumors (n = 25, 16.4%), and procedures related to implantation sinus lift, bone graft etc. (n = 19, 12.3%).

**Table 6:** Awareness of CBCT

Have you heard about CBCT	Percentage
Yes	92.90%
No	3.90%
May be	3.20%

**Table 7:** Use of CBCT reports in clinic

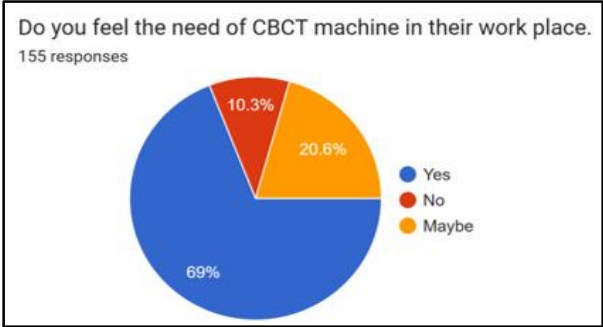
Use of CBCT reports for diagnosis or treatment in clinic	Percentage
Yes	73.50%
No	20.50%

**Table 8:** Presence of CBCT in practice set-up

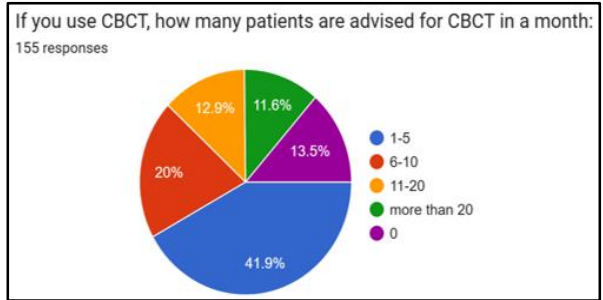
Do you have CBCT in your clinic	Percentage
Yes	39.40%
No	60.60%

**Table 9:** Awareness about working principles of CBCT

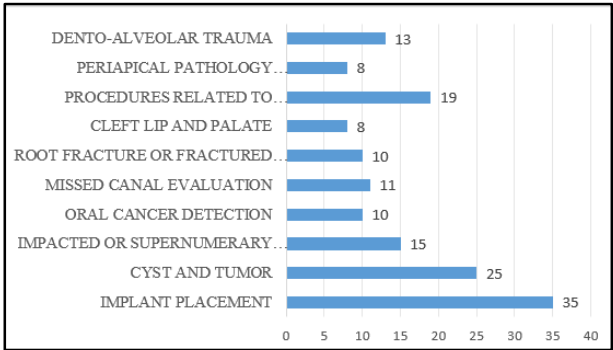
Are you aware of working principle of CBCT	Percentage
Yes	79.40%
No	20.60%



**Figure 4:** Need of CBCT machines in work place



**Figure 5:** CBCT Patients per month



**Figure 6:** Most common reasons of advising CBCT

3.4. Radiation protection knowledge and practice statistics

Of all the 155 participants enrolled in the study, 70.3% considered radiation protection measures like thyroid collar and lead apron necessary in a dental set up. A majority of participants 91% considered CBCT a better diagnostic tool compared to CT scan due to lesser radiation exposure.

**Table 10:** Radiation protection measures in dental set-up

Radiation protection measures being used in dental set up	Percentage
Yes	70.30%
No	29.70%

**Table 11:** Comparison between CBCT and CT

CBCT better than CT as a dental diagnostic tool	Percentage
Yes	91.60%
No	8.40%

#### 4. Discussion

CBCT and digital radiography is gaining popularity in oral diagnosis and treatment fields due to many advantages and better outcome than older imaging modalities.<sup>3</sup> Usage of these modalities is increasing worldwide and even in India usage of CBCT is increasing due to drastic increase in number of CBCT units in India as dental clinicians and colleges felt the need of a better imaging modality.<sup>4</sup>

Dental Council of India does not consider CBCT as a mandatory dental equipment for the dental colleges and even in BDS curriculum specified by DCI has only 1 hour theory dedicated to teach BDS students regarding CBCT which comes under specialized radiographic techniques.<sup>5</sup> CBCT units are also quite expensive equipment to have in each and every dental colleges. For these reasons, many dental colleges do not have a CBCT unit. Thus BDS students have very limited superficial knowledge about this 3-d imaging modality due to lack of practical knowledge and exposure.<sup>6</sup>

Digital radiographic equipment are less expensive and more common in dental colleges although many dental colleges still use older units which require the films to be developed manually. Extra-oral Digital units can be used for imaging modalities like for panoramic radiograph and lateral cephalogram, whereas intraoral sensors are used as a substitute to IOPA films. Digital equipment are present in many Indian dental colleges but it is more commonly used in dental clinics. So practicing dental professionals would have a better knowledge regarding this imaging modalities due to presence of multiple sources of information. Post-graduate students also have more knowledge compared to Under-graduate students regarding digital radiograph and CBCT but most have superficial knowledge and have lack of depth.<sup>7</sup> Though, participants, regardless of their designation, show interest to use CBCT for better diagnosis and treatment plan. Practical exposure and more time allotment for classes regarding these topics are necessary to improve knowledge among BDS students.<sup>8</sup>

This study shows that 144 (92.9%) participants had heard about CBCT whereas Dölekoglu et al study conducted in 2011 shows that 166 dentists (55.9%) and 79.1% academicians had knowledge about cone beam CT (CBCT).<sup>15</sup> Kamburoglu et al. Study showed that only 63.3% of students had heard of CBCT in 2011 which proves there is increased awareness in next 15 years about CBCT.<sup>16-18</sup>

In the present study, the students were broadly categorized into four groups:

1. 1st year to final year BDS students
2. Interns who just passed final year BDS examination
3. Postgraduates who are specializing their respective departments
4. Practicing dental surgeons.

These different categories affect their knowledge and attitude toward the upcoming trends in the field of dentistry.

The positive aspect of this study was that all the participants had some idea regarding the use of digital radiography and CBCT for oro-maxillofacial region.

Radiation protection and safety are very important aspects of dental practice to minimize the risks associated with diagnostic radiographic imaging. Dental professionals and patients are exposed to radiation during routine procedures, and ensuring safety is paramount to protect both patients and dental professionals from unnecessary harm.<sup>11</sup>

Ionizing radiation can potentially cause biological damage if proper precautions aren't taken. Over time, repeated exposure can increase the risk of developing radiation-related effects (stochastic and deterministic effects of ionizing radiation).<sup>12</sup> Therefore, radiation protection guidelines have been established to protect dental professionals from excessive exposure.

The primary principle in radiation safety is the ALARA (As Low as Reasonably Achievable) concept, which focuses on minimizing exposure while ensuring diagnostic quality. This involves using the lowest possible radiation dose, optimizing equipment settings, and ensuring that exposure times are kept to a minimum.

For dental professionals, protection strategies include the use of lead aprons and thyroid shields for patients, proper training and certification in radiation safety, and the use of personal monitoring devices such as dosimeters (like TLD). Additionally, equipment must be regularly maintained and calibrated to ensure it operates efficiently, and safe radiographic techniques must be employed to avoid unnecessary retakes.

In our present study, 70.30% of the participants considered using radiation protection devices such as lead apron and thyroid collar for acquiring radiograph as majority of the dentists and patients were aware of the radiation hazards. ADA strongly advises the use of thyroid collars and lead aprons. While scatter radiation to the patient's abdomen region is minimal, lead aprons should still be worn to reduce the patient's overall radiation exposure.<sup>13</sup>

In our study; 91.60% participants prefer CBCT over CT. This preference is may be due to decreased effective radiation dose per exposure, better resolution, less scanning time etc. Though CBCT has it's own limitations if compared to CT like poor soft tissue contrast, scatter from metallic materials (like Crown, Gutta percha, ornaments), beam hardening.<sup>14</sup>

## 5. Conclusion

CBCT and digital radiography is regarded as the future of orofacial imaging modalities. CBCT has several advantages over Conventional CT like decreased radiation exposure and better resolution of hard tissue structures, but CBCT also has its own limitations like poor soft tissue contrast.

Our present study shows lack of in-depth knowledge of participants (specifically dental students) about CBCT due to lack of practical exposure. Most of the participants had a superficial knowledge as the knowledge gained is mostly theory based. Change in DCI curriculum towards more practical exposure to CBCT and more elaborate theoretical lectures with more time allotted is necessary to teach the future practitioners about CBCT.

It is also very important to know about and follow ALARA principles and radiation protection guidelines to minimize radiation exposure. This survey shows participants had proper knowledge regarding radiation exposure but lack of implementation in about 30% participants. Awareness about radiation protection measures and implementations to our routine dental practice is strongly recommended.

## 6. Source of Funding

None

## 7. Conflicts of Interest

None.

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