

Original Article

Knowledge and Awareness of Cone Beam Computed Tomography Among Interns of Dental College, Lucknow

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ABSTRACT

Objectives: To assess the knowledge and awareness of Cone-Beam Computed Tomography (CBCT) among Dental College, Lucknow interns.

Material and Methods: An online survey was conducted between November 2021 and December 2021 to assess the knowledge & awareness of CBCT among dental interns. A validated questionnaire was prepared based on general awareness and knowledge about CBCT, and it was distributed among 200 interns at the dental college, out of which 126 responded. It was then sent for statistical analysis.

Results: Our study showed that interns know CBCT, have proper knowledge, and are willing to use this imaging modality in their future professional careers.

Conclusion: The study was conducted in a dental institution with a CBCT facility. According to the findings of this study, interns were found to be very aware of CBCT.

Keywords: Awareness, CBCT, Interns, Knowledge, Lucknow

INTRODUCTION

Imaging is an important diagnostic tool in the dental patient's clinical evaluation.^[1] With the invention of 3D imaging, the evolution of dental imaging made giant leaps. The invention of Computed Tomography (CT) in 1973 allowed for diagnosing diseases using three-dimensional images. With the advent of implant surgery, their use became more frequent in dentistry.

They had some major shortcomings like they were large, expensive, and exposed patients to high doses of radiation.^[2] Thus, Arai and colleagues started working on developing compact CT apparatus for use in dentistry. They created a prototype-limited Cone-Beam Computed Tomography (CBCT) that was called Ortho-CT.^[3]

Later, in 2000, Morito Co. Ltd and Nihon University Business Incubation Center developed three-dimensional multi-image CT.^[4] It was called a CBCT machine.

A rotating gantry with an X-ray source and detector is used in CBCT. An ionizing radiation source in the shape of a cone or a pyramid is used. The X-ray source and detector rotate around a fixed rotation fulcrum. During rotation, multiple sequential planar projection images of Field of view (FOV) are acquired. Since CBCT encompasses the entire FOV, image formation requires only one gantry rotation.^[1]

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It is used for the diagnosis of maxillofacial pathologies, including cysts and tumors, and also plays a vital role in planning dental implants, treatment planning in orthodontics, temporomandibular joint (TMJ) evaluation, paranasal sinus examination, assessment of impacted teeth, etc.^[5]

Since there is an increased implication of CBCT in dentistry, dental students, being future dentists, must be well acquainted with the advantages & disadvantages of this piece of imaging modality. This study aims to assess the knowledge and awareness of CBCT among dental interns and their willingness to use it in their future dental practise.^[6]

MATERIAL AND METHODS

An online survey of the current academic session was conducted among interns at the dental college, Lucknow. A total of 200 dental interns were surveyed using the questionnaire through Google Forms.

The survey was conducted between November 2021 and December 2021 and aimed at assessing the knowledge and awareness of CBCT among dental interns. The students were given a close-ended questionnaire consisting of 15 questions.

The questionnaire was self-formulated and validated after discussing the questions with the senior faculty of the Department of Oral Medicine & Radiology.

The Institutional Ethical Committee approved the survey with the referral number FP-02/OMR/2022/IEC.

Approval consent was obtained from interns before the study to reassure them that their responses would be used only for scientific research and that personal details would be kept confidential.

The questions were based on general awareness and knowledge of CBCT, including its usage in endodontics, implant planning, maxillofacial pathologies, etc. The latter also included questions for analyzing how to raise awareness about CBCT and ways to increase the know-how of this particular field.

The inclusion criteria were interns of the current academic session 2021-22 and those willing to participate in the survey.

Students whose forms were half-filled were unwilling to participate; whereas students who did not respond to the questionnaire within 5 days from the day of sharing the questionnaire, were excluded from the study.

Strict confidentiality of students was maintained throughout the study.

STATISTICAL PROCEDURE

Data will be analyzed using Statistical Package for Social Sciences (SPSS) version 22.

RESULTS

A study was conducted among interns at dental college to assess their level of basic knowledge about the principles and applications of CBCT, and their attitude towards using this advanced imaging modality, who were newly doing internship. Two hundred interns were contacted. Out of them, 123 gave their consent and participated in the study. Among them, the mean age of male & female study participants was not found to be significantly different.

When participants were asked whether CBCT is more effective than Orthopantomogram (OPG), most responded 'Yes.' No statistically significant difference could be found among males & females regarding the response to this question.

Many male and female respondents considered CBCT as better regarding radiographic exposure. Among both male and female study participants, a significantly higher proportion of females responded as 'Yes' to this question. No statistically significant difference could be found among males & females regarding the response to this question.

Most male and female respondents reported obtaining information through faculty lessons on CBCT; no statistically significant difference was detected.

When participants were asked which year of undergraduate education CBCT should be included, the majority responded 3rd year as the response to this question.

Almost all the respondents, except 01 female, felt the need for frequent continuing dental education (CDE) workshops to be conducted on CBCT.

When participants were asked which radiographic technique records tissues in 3D, most male and female study participants responded to this question as cone beam computed tomography. No statistically significant difference could be found among males & females regarding the response to this question [Table 1].

The majority of both male & female study participants reported being aware of the working of the CBCT machine [Table 2].

When participants were asked whether CBCT can be used in cancer staging, among male and female study participants, a significantly higher proportion of females responded as 'Yes' to this question. No statistically significant difference could be found among males & females regarding the response to this question [Table 3].

DISCUSSION

Since the introduction of orthopantomography, CBCT imaging has been the most significant technological advancement in maxillofacial imaging. In the early 1980s, CBCT imaging was

Table 1: Which digital radiographic technique records tissues in three-dimension?

			Blank	CBCT	Intraoral Periapical Radiograph	Lateral Cephalogram	OPG	Total
Gender	Males	n	0	16	1	1	1	19
		%	0.0%	84.2%	5.3%	5.3%	5.3%	100.0%
	Females	n	1	98	0	3	5	107
		%	0.9%	91.6%	0.0%	2.8%	4.7%	100.0%
Total		n	1	114	1	4	6	126
		%	0.8%	90.5%	0.8%	3.2%	4.8%	100.0%

P value: 0.183, NS-Non significant

CBCT: Cone-Beam Computed Tomography, OPG: Orthopantomogram, Bold values: number of males and females who responded to the questionnaire

Table 2: Are you aware of the method of working of Cone-Beam Computed Tomography machine?

			Blank	No	Yes	Total
Gender	Males	n	1	4	14	19
		%	5.3%	21.1%	73.7%	100.0%
	Females	n	1	26	80	107
		%	0.9%	24.3%	74.8%	100.0%
Total		n	2	30	94	126
		%	1.6%	23.8%	74.6%	100.0%

P value: 0.372, NS-Non significant, Bold values: number of males and females who responded to the questionnaire

Table 3: Can Cone-Beam Computed Tomography be used in cancer staging?

			No	Yes	Total	
Gender	Males	n	2	6	11	19
		%	10.50%	31.60%	57.90%	100.00%
	Females	n	1	28	78	107
		%	0.90%	26.20%	72.90%	100.00%
Total		n	3	34	89	126
		%	2.40%	27.00%	70.60%	100.00%

P value: 0.031, S-significant, Bold values: number of males and females who responded to the questionnaire

first commercially developed for angiography.^[7] Dentists later adopted the technology for imaging the maxillofacial region in the late 1900s.

A cone-shaped beam of divergent X-rays emanates from the X-ray source in CBCT units. The detector in CT machines is a linear array, but it is a flat two-dimensional (2D) panel. A tissue volume can be covered in a single rotation around the head and neck region. Using this technique, we can create a 3D image volume from a 2D dataset.^[1]

Although CBCT is used in various aspects of maxillofacial diagnosis and thus aids in proper treatment planning, it is discovered that students during their internship know little about its principle, applications, and necessity in maxillofacial imaging.

In our study, questions were designed to elicit basic knowledge about digital imaging techniques, three-dimensional

imaging, the advantages of three-dimensional imaging over two-dimensional imaging, why to choose CBCT over CT, the primary applications of CBCT in maxillofacial imaging, and the efficacy of CBCT in diagnosing jaw pathologies when compared to 2D imaging modalities, among other things.

Some questions were formulated to learn about interns' attitudes toward the importance and application of CBCT in their future careers, and their views on including CBCT-based curricular activities and workshops in undergraduate training courses.

In our study, most interns (90.5%) knew that CBCT records tissues in 3Ds. It is more productive than traditional 2D radiographs because it leverages a cone-shaped ionizing beam that reduces radiation exposure to the patient while achieving high-quality 3D visuals. Similar findings were seen in the study by Nazia *et al.*,^[6] where 71.3% of interns were aware that CBCT records tissues in 3Ds.

Our research discovered that CBCT was more helpful than an OPG for identifying jaw pathologies. OPG only records images in superior-inferior and mesio-distal planes or mesio-distal and bucco-lingual. However, CBCT, rather than OPG, provides the most accurate 3-D extent of lesion and pathology involvement with the surrounding structure. Interns had a higher level of knowledge (96.3%) regarding this. The higher response to the above question could be because the institution where the study was conducted has a CBCT facility. Sivesh *et al.*^[8] found similar results, with 83.2% of interns believing CBCT was more effective than OPG in detecting jaw pathologies.

According to this study, most interns (74.6%) knew the "Method of action of the CBCT machine." Instead of the slice-by-slice imaging found in conventional CT, a CBCT machine uses a cone-shaped beam and a reciprocating solid-state flat panel detector that rotates once around the patient 80-360 degrees, covering the defined anatomical volume. Unlike stacked axial slices in CT, this single scan (rotation) captures planned data, reducing the absorbed X-ray dose by 6 to 15 times. The scanning time of CBCT equipment varies

from nearly 5 to 40 seconds, depending on the manufacturer. The X-ray parameters of CBCT are comparable to those of panoramic radiography, with a typical operating range of 1-15 ma at 90-120 kvp, whereas CT has a significantly higher operating range of 120-150 ma and 220 kvp. Similar results were observed in the study by Nazia *et al.* In a study conducted by Lavanya *et al.* among postgraduate students in India, only 68.2% were aware of the basic operation of CBCT. Thus, CBCT should be included in our curriculum because it was discovered in our study that students who were taught and practically exposed to CBCT imaging had better knowledge about the application of CBCT than in other studies where less than 1% of interns knew about the same.

In our study, most interns (81.0%) felt that CBCT was preferable to multiple 2-D radiographs regarding radiographic exposure." The effective dose (E) varies depending on the type and model of CBCT equipment used and the FOV. Furthermore, changing patient positioning (tilting the chin) and using additional personal protection can reduce up to 40% of the dose (thyroid collar). CBCT provides a patient radiation dose of 5 to 74 times that of a panoramic X-ray or 3 to 48 days of background radiation. Compared to the patient dose reported for oral and maxillofacial imaging by conventional CT, CBCT offers significant dose reductions ranging from 98.5% to 76.2% (approximately 2000 msv). According to a study by Nazia *et al.*,^[6] most interns (44.7%) believed that CBCT was only better than 2D radiographs in terms of radiographic exposure in some cases.

According to the results, CBCT can be used for cancer staging (70.6%). Soft tissue analysis requires higher resolution for cancer staging that CBCT cannot provide. As a result of its poor soft tissue resolution, CBCT is not recommended. Thus, the findings are consistent with Sivesh *et al.*,^[8] in which 85.4% of interns believed that CBCT could be used in cancer staging.

Most interns (78.9%) learned about CBCT from faculty lessons. Students gained a clear understanding of the fundamentals of CBCT and its indications, mode of action, limitations, and so on through faculty lessons, as they interacted with experts in the field. In addition to theoretical knowledge, students were exposed to practical demonstrations, which could explain why many interns responded this way. Similar findings were observed in the study by Roshene *et al.*,^[9] in which most interns (48.7%) obtained knowledge through faculty lessons.

Most interns (53.2%) believed that CBCT should be included in the third year of undergraduate dental education. From 2023, students are being imparted knowledge about the fundamentals of radiology and assigned to clinics too. Sivesh *et al.*^[8] and Roshene *et al.*^[9] discovered similar results about this study.

The majority of interns (96.8%) were "willing to use CBCT in their future professional career," they also suggested that CDE/

workshops be held regularly to acquire knowledge on CBCT for a better understanding of CBCT. We can have a better treatment plan and results of treatment, and be well-prepared to manage complications that may arise during treatment, because CBCT aids in implant planning, determining bone density, evaluating pathologies, and surgical resections. According to Sivesh *et al.*^[8] and Roshene *et al.*,^[9] 94.9% of interns were willing to use CBCT in their future careers.

CONCLUSION

The study was conducted in a dental institution with a CBCT facility.

According to the findings of this study, interns were found to be apprised of CBCT.

No statistically significant difference was seen between males and females regarding the responses to most of the questions.

The study showed that female respondents were less willing to use CBCT in their future careers.

Ethical approval

The author(s) declare that they have taken the ethical approval from IEC (FP-02/OMR/2022/IEC).

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of Artificial Intelligence (AI)-Assisted Technology for manuscript preparation

The authors confirm that there was no use of Artificial Intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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