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Utilization and Perceptions of Cone Beam Computed Tomography (CBCT) in Endodontic Practice: A Survey of Dentists in Sulaimania, Erbil, and Duhok Cities

Chro Muhsin Ameen * Bestoon Mohammed Faraj **

Abstract

Background and objectives: Cone Beam Computed Tomography has become an increasingly important tool in dental practice, offering high-resolution three-dimensional images with lower radiation exposure compared to traditional computed tomography. This study aims to investigate Cone Beam Computed Tomography utilization, perception among dentists in Sulaimania, Erbil, Duhok cities.

Methods: A cross-sectional survey conducted among dentists in Sulaimania, Erbil, and Duhok cities in 2022. A sample of 385 dentists (general dental practitioner and specialist) participated in this survey. Demographic information and experience with Cone Beam Computed Tomography were collected. Data were analyzed using descriptive statistics, chi-squared tests, and regression analysis.

Results: from the total of 385 dentists, 221 (57.4%) had taken a course on root canal treatment, while 56 (14.5%) had a training course in Cone Beam Computed Tomography. Only 53 (13.8%) reported having a Cone Beam Computed Tomography device in their practice. Among those with access, 16 (4.2%) reported using it for follow-up, 131 (34.0%) for diagnosis, 151 (39.2%) for treatment planning, and 149 (38.7%) for assessing treatment success. It was more commonly used for diagnosing vertical root fractures (60.8%) and apical lesions (18.2%). A significant majority (94.3%) used it to assess lesion size. Reasons for not using included cost (80.0%), unavailability (60.5%), and radiation concerns (53.5%).

Conclusion: This study provides insights into the utilization and perceptions of Cone Beam Computed Tomography among dentists. While it offers benefits, adoption is influenced by cost, availability, and radiation concerns.

Keywords: Cone Beam Computed Tomography, Dental imaging, Dental practice, Endodontics, Root canal treatment

*B.D.S Kurdistan Higher Council of Medical Specialties /Restorative Dentistry trainee, Shorsh Dental Center, Kurdistan Region, Iraq. Corresponding author: chro.muhseen@gmail.com
** B.D.S. H.D.D. M.Sc. PhD. Professor, Conservative Department, School of Dentistry, Faculty of Medical Sciences, University of Sulaimani. Kurdistan Region, Iraq. Email: bestoon.faraj@univsul.edu.iq

Introduction

Cone Beam Computed Tomography (CBCT) has emerged as a transformative imaging technology in endodontics over the last two decades.[1, 2] Unlike traditional radiography, CBCT offers three-dimensional imaging capabilities with superior spatial resolution and lower radiation exposure compared to conventional computed tomography (CT) scans.[3, 4] A key strength of CBCT is its exceptional ability to visualize intricate root canal anatomies.[5, 6] Endodontists can now identify anatomical complexities like accessory canals, lateral canals, and apical areas with remarkable clarity – features that are often obscured in conventional two-dimensional radiographs.[7, 8] Moreover, CBCT has demonstrated unparalleled accuracy in detecting vertical root fractures, a critical diagnostic challenge with significant implications for treatment outcomes. [9, 10]Beyond its diagnostic abilities, CBCT imaging has profoundly impacted endodontic treatment planning and clinical decision-making processes.[11, 12] A substantial body of evidence highlights how CBCT imaging frequently leads to modifications in treatment strategies.[13, 14] A systematic review by Kruse et al.[5] concluded that CBCT significantly enhances the detection of apical periodontitis, root fractures, and complex root canal anatomies compared to conventional periapical radiographs. Similarly, Ee et al. reported that CBCT imaging prompted changes in treatment plans for approximately 62% of endodontic cases examined. [6] The benefits of CBCT extend beyond diagnosis and treatment planning, as it also plays a pivotal role in evaluating treatment outcomes and monitoring the healing of periapical lesions following endodontic therapy.[15,16] With its superior three-dimensional visualization capabilities, CBCT enables endodontists to meticulously assess the periapical region, identify potential complications, and detect persistent lesions that may necessitate further intervention. [17, 18] Despite its well-documented advantages, the widespread adoption of CBCT in endodontic practice has been influenced by various factors, including cost, availability, radiation concerns, and the need for specialized training.[19-21] Several studies have highlighted the substantial financial investment required for CBCT equipment, raising concerns about cost-effectiveness, particularly for smaller dental practices.[22, 23] Additionally, the issue of radiation exposure has garnered significant attention, prompting professional organizations like the American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiology (AAOMR) to advocate for judicious and evidence-based use of CBCT. [24-26] This study aims to investigate the utilization and perceptions of CBCT among dentists practicing in Sulaimania, Erbil, and Duhok cities in the Kurdistan Region of Iraq.

Materials and methods

This cross-sectional survey study involved 385 dentists practicing in Sulaimania, Erbil, and Duhok cities in the Kurdistan Region of Iraq. A structured questionnaire was used to collect data on demographic characteristics, including years of practice, specialization, and training in root canal treatment (RCT) and CBCT. Participants were asked about the availability of CBCT devices in their practices and their utilization of CBCT in various endodontic procedures, such as diagnosis, treatment planning, follow-up assessments, and evaluation of treatment outcomes. Additionally, information was gathered on the reasons for not using CBCT when applicable, such as cost, unavailability, and radiation concerns. The ethics committee of Kurdistan Higher Council of Medical Specialties (KHCMS) granted approval for the present study under reference number 1207 on June 2nd, 2022. The collected data were analyzed using IBM SPSS statistical software (version 24).

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Descriptive statistics were applied to summarize the sample characteristics and CBCT utilization patterns. Chi-squared tests and regression analysis were employed to identify potential factors associated with CBCT usage, including age, years of practice, specialization, and training in RCT and CBCT with P- values equal or less than 0.05 were regarded as statistically significant.

Results

The sample consisted of dentists primarily located in Sulaimania (45.7%), followed by Erbil (32.7%) and Duhok (21.6%). A majority of dentists (57.4%) had taken a course on Root Canal Treatment (RCT), while (14.5%) had taken a course on CBCT. Only 13.8% of dentists had a CBCT device in their practice. Common diagnostic aids included periapical radiographs (83.6%), cold and hot tests (38.2%), and probes (32.5%). CBCT was primarily used for diagnosis (34.0%), treatment planning (39.2%), and assessing treatment success (38.7%). Table (1) The mean years in dental practice among the dentists were approximately 9.49 years, with a standard deviation of 6.18 years. Dentists reported practicing root canals for a mean duration of approximately 8.48 years, with a standard deviation of 5.49 years. The minimum reported years of practice and practicing root canals were 2 years, while the maximum reported years were 47 years and 42 years, respectively. The majority of dentists belonged to the 25-35 years age group, with approximately 190 participants. This group represented the largest segment of dental professionals who took part in the survey. The second-largest age group was >35 years, with around 122 respondents. This indicates a significant representation of more experienced dentists in the survey. The <25 years age group had the lowest participation, with only about 47 respondents. This is likely because dentists in this age range are typically still in training or at the very early stages of their careers. Figure (1) CBCT was utilized for diagnosing vertical root fractures (60.8%), assessing apical lesions (18.2%), and determining lesion size (94.3%). Resorption was assessed using CBCT by 30.9% of dentists and periapical radiographs by 71.9%. Common reasons cited for not using CBCT included cost (80.0%), unavailability (60.5%), and concerns about radiation exposure (53.5%). Additionally, a Pearson chi-square test was conducted to assess the association between several potential factors and the utilization of CBCT for diagnosis and follow-up in dental practice. Table (2) Younger dentists were significantly more likely to use CBCT for diagnosis (p = 0.018). Age was not significantly associated with CBCT utilization for follow-up (p = 0.503). Dentists that participated in a RCT training course were significantly more likely to use CBCT for both diagnosis (p = 0.001) and follow-up (p = 0.049) compared to those does not participate in a RCT training course. Dentists who had a CBCT course showed a significant preference for using CBCT in diagnosis (p= 0.001). However, there was no significant association between CBCT course completion and its use for follow-up (p = 0.226). The presence of a CBCT device significantly influenced its utilization for diagnosis (p = 0.000) but not for follow-up (p = 0.555). Age, specialized training (particularly in RCT and CBCT), and the availability of CBCT equipment significantly influenced its utilization for diagnosis in dental practice. However, these factors did not exert the same level of influence on CBCT utilization for follow-up assessments. Table (2).

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Table (1): The main characteristics of the sample

Characteristics		Number	Percentage
Total		385	100
City	Sulaimania	176	45.7
	Erbil	126	32.7
	Duhok	83	21.6
Course of RCT	Yes	221	57.4
	NO	164	42.6
Course of CBCT	Yes	56	14.5
	NO	329	85.5
Having CBCT Device	Yes	53	13.8
	NO	332	86.2
Diagnostic aids	Cold and hot	147	38.2
	Periapical radiograph	322	83.6
	Probe	125	32.5
	Microscope	27	7.0
Number of canals	Loupe	82	21.3
	Periapical	292	75.8
	CBCT	87	22.6
Follow up with CBCT	Yes	16	4.2
	No	369	95.8
Use of CBCT	Dx	131	34.0
	Treatment plan	151	39.2
	Success	149	38.7
Vertical root fracture	CBCT	234	60.8
	OPG	24	6.2
	PA	159	41.3
Apical Lesion	CBCT	70	18.2
	OPG	72	18.7
	PA	279	72.5
Using CBCT for size of lesion	Yes	363	94.3
	No	22	5.7
Resorption	CBCT	119	30.9
	Periapical	277	71.9
Causes of not using CBCT	Cost	308	80.0
	Unavailable	233	60.5
	Radiation	206	53.5

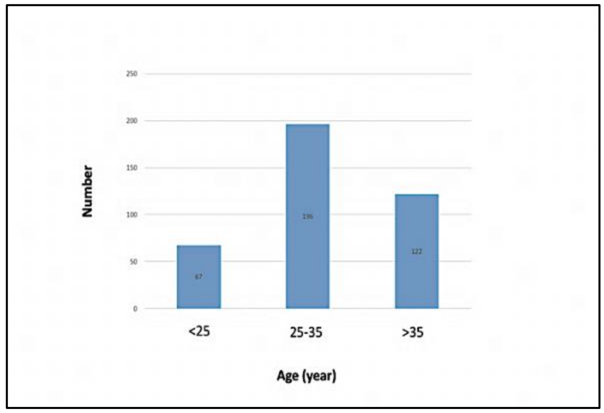

Figure (1): Age distribution of the sample

Table (2): The use of CBCT for the diagnosis and follow up in relation to potential factors using Pearson chi-square test

Potential factors		Dx CBCT		p value	Follow up CBCT		p value
		NO	Yes		No	Yes	
Age	<15	60	7	0.018	64	3	0.503
	25-35	156	40		190	6	
	>35	88	34		115	7	
RCT course	No	143	21	0.001	161	3	0.049
	Yes	161	60		208	13	
CBCT course	No	274	55	0.000	317	12	0.226
	Yes	30	26		52	4	
Having CBCT device	No	277	55	0.000	319	13	0.555
	Yes	27	26		50	3	

The p value less than 0.05 is regarded as significant.

Discussion

The integration of cone-beam computed tomography (CBCT) into contemporary endodontic practice has been widely acknowledged, as evidenced by the findings of this study and a multitude of previous investigations.[1-4] CBCT offers superior diagnostic capabilities compared to conventional two-dimensional radiographs, particularly in delineating complex root canal anatomies, identifying vertical root fractures, and detecting apical periodontitis. [5-7] The

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finding that CBCT was primarily utilized for treatment planning (39.2%), assessing treatment success (38.7%), and diagnosis (34.0%) aligns with numerous studies highlighting the impact of CBCT on clinical decision-making and treatment planning.[1-7] A systematic review by Kruse et al.[5] concluded that CBCT imaging significantly improves the detection of apical periodontitis, root fractures, and complex root canal anatomy compared to periapical radiographs. Ee et al. reported that CBCT imaging led to a change in treatment plan in approximately 62% of endodontic cases. [6] The preference for CBCT in detecting vertical root fractures (60.8%) and assessing lesion size (94.3%) is consistent with findings demonstrating its superiority over conventional radiographs in these applications.[8-12] For instance, Liang et al. reported that CBCT significantly improved the detection of root canal curvatures, lateral canals, and apical deltas. [10] However, the lower utilization of CBCT for diagnosing apical lesions (18.2%) compared to periapical radiographs (72.5%) contrasts with some studies that have reported improved detection of periapical lesions using CBCT. [5,6] Systematic reviews and meta-analyses have consistently demonstrated the enhanced diagnostic accuracy afforded by CBCT imaging, leading to a profound impact on clinical decision-making and a substantial proportion of endodontic cases experiencing changes in treatment plans. [5-7] Despite the advantages of CBCT, barriers such as cost (80.0%), unavailability (60.5%), and radiation concerns (53.5%) were identified in this study, which are well-recognized in the literature.[13-18] Several studies have highlighted the significant investment required for CBCT equipment and the potential impact on cost-effectiveness.[19-22] Additionally, concerns regarding radiation exposure have been consistently emphasized, with guidelines from organizations like the American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiology (AAOMR) advocating for judicious use of CBCT. [23-25] The association between attending relevant courses (RCT and CBCT) and increased utilization of CBCT for diagnosis and follow-up aligns with findings emphasizing the need for proper training and expertise in interpreting CBCT images.[1, 26-28] Continuous education and collaboration with radiologists or specialized endodontists have been recommended to improve the accuracy of CBCT image interpretation. [26-28] The low utilization of CBCT for follow-up purposes (4.2%) in this study contrasts with some studies that have reported higher rates of CBCT use for post-treatment evaluation.[29, 30] However, judicious use of CBCT for follow-up should be based on specific clinical indications and patient factors, rather than routine use in all cases. [24, 25, 28] While not explicitly discussed in the study findings, some studies have highlighted the potential for overutilization or overinterpretation of CBCT images, leading to unnecessary interventions or treatment modifications.[11,27,25] These studies emphasize the importance of appropriate training and adherence to clinical guidelines to ensure responsible and evidence-based use of CBCT in endodontic practice.

Conclusion

This research provides valuable perspectives on how dentists in Sulaimania, Erbil, and Duhok view and utilize cone beam computed tomography (CBCT), particularly for endodontic procedures. The findings underscore the significant diagnostic, treatment planning, and outcome assessment advantages that CBCT offers, aligning with the growing evidence supporting integrating this technology into modern endodontic care. However, the study also identifies barriers like cost, availability limitations, and radiation concerns that are hindering CBCT's

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widespread adoption. These factors highlight the need for concerted efforts to increase access to CBCT training and address potential limitations, ultimately enabling responsible and evidence-based utilization of this advanced imaging modality.

Conflicts of interest

No conflicts of interest were present.

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