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Awareness and Attitudes of Cone Beam Computed Tomography Among Afghan Dentists In Kabul, Afghanistan

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Abstract

Background: Cone Beam Computed Tomography (CBCT) offers precise three-dimensional imaging with reduced radiation exposure compared to traditional methods, significantly advancing dental diagnostics. There remains a notable gap in understanding dentists' awareness and adoption of CBCT in Kabul, Afghanistan. This study aims to investigate and address this gap by evaluating the current knowledge and practices related to CBCT among dental professionals in Kabul.

Materials and Methods: This observational cross-sectional study conducted in Kabul, Afghanistan, surveyed 1000 Afghan dentists using a 17-item close-ended questionnaire adapted from validated previous studies. Data collection was conducted in person, and descriptive statistics, including frequencies and percentages, were computed. Chi-square tests were then used to assess significant differences.

Results: Our study revealed that the majority of dentists were knowledgeable about CBCT (88.3%). Awareness of CBCT was higher among specialists (100%) compared to GDPs (83.6%). Most participants (62.2%) acquired information about CBCT from faculty lessons. Only 9% reported not working with digital radiography. A significant percentage of GDPs (62.5%) and one-third of specialists (27%) disagreed that the faculty provided adequate education regarding CBCT. 83.2% of contributors believed CBCT availability at dental faculties was essential. Satisfaction with CBCT use was lower among GDPs (59.8%) compared to specialists (76.7%).

Conclusion: This study highlights the significant role of CBCT in dentistry, emphasizing its importance as perceived by the study participants. It underscores the necessity for dental curricula to integrate practical CBCT training with clinical courses, aiming to enhance students' proficiency and understanding of this essential technology.

Keywords: awareness, cone beam computed tomography, dental imaging, Afghanistan

Introduction

Cone beam computed tomography (CBCT) was developed as an advanced imaging technology in the dental field. Its main goal was to provide an alternative to the bulky, expensive, and high-radiation traditional medical radiological scans **[1-3]**. Previous studies have shown that cone beam computed tomography (CBCT) scans are more accurate than traditional scans **[4, 5]**. The American Association of Oral and Maxillofacial Radiology has affirmed that cross-sectional views are advised for accurate dental implant planning **[6-8]**. This can be effectively achieved using cone beam computed tomography, which is user-friendly and provides a low radiation dose. In dental implantology, three-dimensional imaging can be obtained using dental cone beam computed tomography, offering volumetric data of the jaws and teeth with comparatively low exposure and cost **[9-11]**.

Globally, the use of CBCT in dentistry has grown significantly due to its clear benefits over traditional imaging methods. It is now a crucial tool across various dental specialties such as implantology, orthodontics, and endodontics, where its detailed three-dimensional images are essential for accurate diagnosis and treatment planning. As CBCT has become more accessible and affordable in many regions, its integration into standard dental practice has increased. Research from various regions underscores the increasing reliance on CBCT to enhance the accuracy and safety of dental procedures **[12-14]**.

In contrast, the situation in Afghanistan is quite different. The use of CBCT in Afghan dental practices faces significant obstacles due to the country's unique socio-economic and educational challenges. Ongoing conflict, economic instability, and a weakened healthcare system have greatly restricted the resources needed to purchase and maintain advanced medical technologies such as CBCT. The high cost of CBCT equipment, combined with the lack of financial support or government subsidies, makes it unaffordable for most dental practitioners in Afghanistan. This financial limitation is a major obstacle to the widespread use of CBCT in the country.

Since the invention of X-rays a century ago, dental radiographs have served as the primary source of diagnostic information for the head and neck region **[15, 16]**. However, two-dimensional imaging methods are unable to accurately represent complex three-dimensional anatomical structures and associated pathologies. Therefore, given the increasing availability of CBCT in dental practices, the authors aimed to evaluate the current knowledge and awareness of Cone Beam Computed Tomography among dentists in Kabul, Afghanistan.

Materials and Methods

One thousand self-administered questionnaires were randomly distributed to dental practitioners in Kabul, the capital city of Afghanistan, over a five-month period (September 2023 to March 2024), following ethical approval from the Research Ethics Committee of Khatam AL Nabieen University (AF, knu.edu.af.rec 03, 15-Aug-2023). The questionnaires were printed and personally distributed by the authors. Prior to presenting the questionnaire to dentists, the authors clarified the study's objectives, and dentists indicated their agreement by signing the consent form. The study was conducted in accordance with the protocols and principles outlined in the Helsinki declaration (1964 and subsequent revisions). The sample of 1000 dentists were selected using a simple random sampling method **(figure 1)**.

The questionnaire consisted of 17 close-ended questions and was adapted from validated previous studies **[17-19]**. Only fully completed questionnaires were included in the analysis. The first three questions concerned with gender, practice experience and qualification and the remaining questions were related to CBCT awareness, advantages, application, and practice.

Statistical analysis

Following the collection of responses, the data were coded. The analysis was conducted using IBM SPSS Statistics 25. Participants' responses regarding qualification levels were compared using a chi-square test for quantitative data, with significance determined at ($P \leq 0.05$). Descriptive statistics, including frequencies and percentages, were also computed.

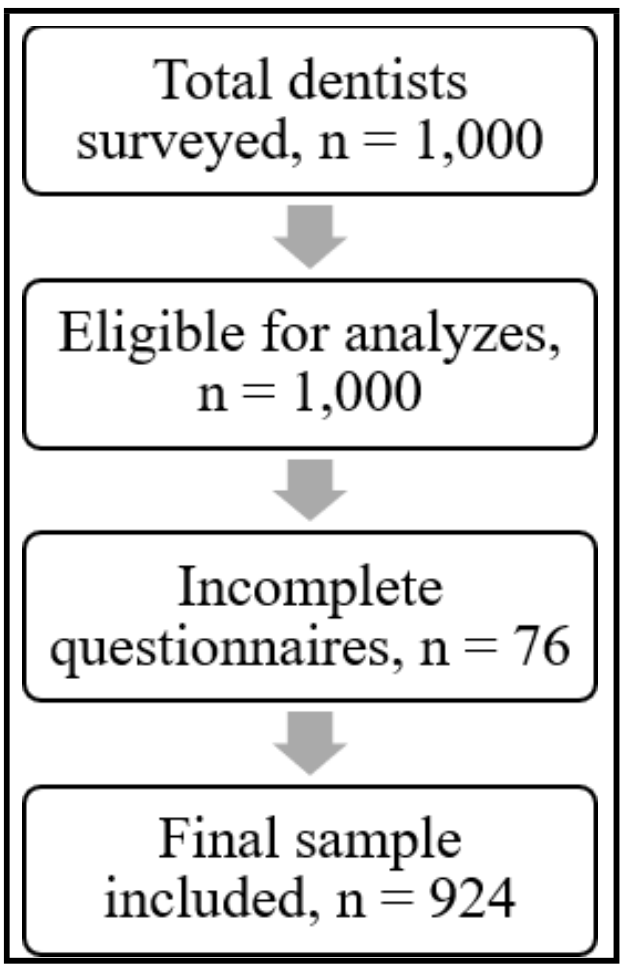

Figure 1: **Flow Diagram of Study Participants**. This diagram illustrates the process of participant selection for the study on CBCT awareness and attitudes among dentists in Kabul. Out of the initial 1,000 surveys distributed, 76 questionnaires were excluded due to incomplete responses, resulting in a final sample of 924 complete and analyzable responses

Results

Among the 1,000 dentists surveyed, 924 (92.4%) completed the questionnaire. Hence overall 924 questionnaires were analyzed including 788 (85.3%) male and 136 (14.7%) female. The majority of participants, 542 (58.7%), reported having less than five years of experience in dental practice since graduation, while 382 (41.3%) indicated work experiences of over five years. Of the participants, 662 (71.6%) were general dental practitioners (GDPs) and 262 (28.4%) were specialists.

The majority of participants declared full awareness of CBCT, with (83.6%, n = 554) of GDPs and (100%, n = 262) of specialists, showing a significant difference (P < 0.05). Most participants (62.2%) acquired their knowledge of CBCT at university, while only 4.7% learned about it from senior colleagues. There was a notable difference between the responses of GDPs and specialists (P < 0.05) **(Table 1)**.

The results showed that half of the specialists had attended courses related to CBCT, while more than half (65.8%) of GDPs had attended such courses, with a significant difference in their responses (P < 0.05). Among the 924 participants, only 84 (12.6%) had not used digital radiography, whereas all 262 specialists (100%) and 578 GDPs (87.3%) had used digital imaging, also showing a significant difference between GDPs and specialists (P < 0.05).

Overall, half of the participants reported that the most common reason for using digital radiography is its lower radiation dose. This was followed by the comfort in acquiring and processing images, cited by 13.09% (n=121) of participants. The least common reason, mentioned by 6.4% (n=60) of participants, was the ease of storage **(Table 2)**.

The majority of GDPs (81.5%, n=540) mentioned higher costs as the primary reason for not using digital imaging, while only 0.3% (n=2) mentioned difficulties in image acquisition and processing as the least common reason. Specialists expressed similar sentiments to GDPs, with a statistically significant difference noted between their responses (P = 0.05) **(Table 3)**.

Among GDPs, 282 (42.5%) and among specialists, 113 (42.7%) expressed interest in using CBCT primarily for dental implants, followed by evaluating impacted teeth and trauma cases. Significant differences were observed in their responses (P < 0.05).

From the perspective of GDPs, the primary advantage of CBCT over medical CT was its lower radiation dose (41.9%), with easier image processing due to limited beam noted secondarily (21.4%). In contrast, specialists highlighted shorter scanning times (37.7%) and lower radiation doses compared to CT (35.4%) as significant advantages. Significant differences were also noted between the responses of GDPs and specialists regarding CBCT advantages (P < 0.05).

It was found that more than half of GDPs (67.3%, n=446) and 32.7% of specialists (n=93) had not referred their patients to CBCT imaging, while the majority of specialists had done so, indicating a significant difference between their responses (P < 0.05). Additionally, 40.7% of GDPs (n=270) and 61.8% of specialists (n=162) believed that CBCT will be used in all specialties of dentistry. About one-fourth of GDPs and only 3.8% of specialists had no idea about the future use of CBCT in routine dental practice, with a significant difference observed between their responses (P < 0.05) **(Table 4)**.

A majority of GDPs and specialists (83.2%) indicated that CBCT technology is essential in dental institutions, with a significant difference in their responses (P < 0.05). Furthermore, more than half of both groups preferred that CBCT lectures be introduced in the fourth year of dental education, with significant differences observed between their responses (P = 0.05).

The majority of GDPs (62.5%, n=414) acknowledged that their faculty provided sufficient education on CBCT, compared to only 27.1% (n=71) of specialists, indicating a significant difference in responses (P < 0.05). Additionally, both GDPs and specialists expressed considerable satisfaction with the use of digital imaging, with 59.8% (n=396) of GDPs and 76.7% (n=201) of specialists reporting high levels of satisfaction.

Table 1: The resources that participants obtained their CBCT awareness

Resource	GDPs	Specialists	P value
Faculty lessons	400 (60.4%)	175 (66.8%)	0.000
Seminars/workshops	74 (11.1%)	48 (18.3%)	
Internet	52 (7.9%)	13 (4.9%)	
Seniors	28 (4.3%)	16 (6.2%)	
Others	108 (16.3%)	10 (3.8%)	

Note: Chi-square test was used to analyze the differences in the distribution of CBCT awareness resources between GDPs and specialists. The Pvalue indicates statistical significance.

Table 2: Reasons behind using digital imaging GPDs and dental specialist in Kabul, Afghanistan

Reason	Less radiation dose	Short exposure time	Easy to store data	No developing required	Adjustment and measurements can be made	No artifact
GDPs	336 (50.7%)	38 (5.7%)	60 (9.1%)	60 (9.1%)	76 (11.5%)	92 (13.9%)
Specialists	128 (48.8%)	32 (12.3%)	0	57 (21.7%)	45 (17.2%)	0

Table 3: Reasons behind not using digital imaging

Reason	High costs	Lack of skills	No idea	Hard to perform
GDPs	540 (81.5%)	6 (0.9%)	114 (17.2%)	2 (0.3%)
specialists	198 (75.5%)	0	64 (24.4%)	0
P = 0.028				

Note: Chi-square test was used to compare reasons for not using digital imaging between GDPs and specialists. The P value of 0.028 indicates a statistically significant difference.

Table 4: Perspective of using CBCT in routine dental practice in near future

Perspective	It will not be used	In all specialties of dentistry	For selected dental applications	Limited use	No idea
GDPs	10 (1.5%)	270 (40.7%)	134 (20.2%)	104 (15.8%)	144 (21.8%)
Specialists	29 (11.1%)	162 (61.8%)	0	61 (23.3%)	10 (3.8%)
P = 0.000					

Note: Chi-square test was used to compare perspectives on the future use of CBCT between GDPs and specialists. The P value of 0.000 indicates a statistically significant difference in perspectives between the two groups.

Discussion

The expanding applications of CBCT in dentistry have been well studied and articulated around the world due to its effective diagnostic power **[19]**. However, to the best of the authors' knowledge, there has been a lack of studies in Afghanistan investigating dentists' knowledge and attitudes toward CBCT recognition and applications. This questionnaire-based study was designed to address this gap and offer recommendations where necessary.

Our study found that the majority of participants (87.2%, n=806) were aware of CBCT to some extent. Awareness was 83.6% among general dental practitioners (GDPs) and 100% among specialists, with a significant difference in their responses ($p < 0.05$). This finding aligns with a study conducted in Turkey, where most dental students were also aware of CBCT. At Ankara University, CBCT awareness was similar between fifth year and postgraduate students but higher than among fourth-year students. Conversely, at Gazi University, postgraduate students demonstrated greater awareness than undergraduate students ($p < 0.05$) **[20]**.

These results suggest that while there is a high level of awareness among specialists, GDPs have less exposure to CBCT knowledge. This discrepancy highlights a critical need for improving CBCT education among GDPs. In the broader context of dental education in Afghanistan, integrating CBCT training into the curriculum at an earlier stage could bridge this gap.

In addition, our study revealed that 60.4% of GDPs and 66.8% of specialists acquired their knowledge of CBCT solely from faculty lessons. In contrast, senior colleagues played a lesser role in forming CBCT knowledge, contributing to just 4.3% of GDPs and 6.2% of specialists. These results differ from Kamburoğlu et al. **[20]** findings, where over half of postgraduate students learned about CBCT in seminars, compared to only 3.3% of undergraduate students. However, our results are consistent with Noaman et al.'s study, which showed that most postgraduate and undergraduate students obtained their CBCT education from faculty lessons **[21]**.

When asked about the advantages of CBCT over medical CT, 40.1% of GDPs and specialists identified the lower radiation dose as the most significant benefit, followed by shorter scanning times (21.1%), with the least important factor being cost (3.7%). This finding is consistent with a prior study in Turkey **[22]**, where the low radiation dose was also considered the most significant advantage, although the least important factor differed. Despite the lower radiation dose of CBCT compared to medical CT, earlier researchers **[23-26]** has reported that the effective dose of CBCT is significantly higher than that of standard two-dimensional dental imaging techniques.

Li G **[27]** explained that the effective dose of CBCT varies depending on the type of scanner, with larger fields of view (FOV) and higher spatial resolution resulting in a higher dose.

In our study, 62.6% of GDPs disagreed that their formal university education provided insufficient knowledge and skills regarding CBCT, while 72.9% of specialists felt the opposite. This difference may be due to the availability of CBCT equipment during their education, with specialists likely having more access to modern facilities. Consistent with our findings, Kamburoğlu et al **[20]** reported that a significant proportion of both undergraduate and postgraduate students felt that their faculty education did not adequately cover CBCT.

The discrepancy in perceptions between GDPs and specialists regarding CBCT education highlights a need for targeted educational interventions. For GDPs, focused workshops and continuing education programs could address the gaps in their CBCT knowledge. For specialists, advanced training sessions and specialized courses could enhance their existing skills and knowledge.

In this study, a majority of GDPs (70%, n=464) and specialists (59.9%, n=157) advocated for including CBCT lectures in the fourth year of dental education. This finding aligns with a study in Turkey **[20]**, where 69% of participants also supported integrating CBCT education into clinical lectures. Similarly, a study in Nepal **[28]** revealed that dentists preferred introducing CBCT education during the fourth year of the Bachelor of Dental Surgery (BDS) program.

Based on these findings, it is recommended that CBCT training be introduced in the fourth year of dental education across all dental schools in Afghanistan. This training should include hands-on sessions with CBCT machines to enhance practical skills and understanding. Developing a standardized CBCT curriculum and including it in national dental education guidelines could ensure consistent and comprehensive training across institutions.

In our study, 87.3% of GDPs and 72.1% of specialists expressed a preference for having CBCT machines available in dental institutions. These results closely align with those of Kamburoğlu K et al **[20]**, where a significant majority (91%) of participants also expressed a preference for having a CBCT unit at their dental institution.

The high demand for CBCT machines in dental institutions underscores the need for infrastructural improvements. It is crucial to establish centralized CBCT facilities in major dental schools and regional dental centers to provide access to these advanced imaging tools. Public-private partnerships could be explored to facilitate the acquisition and maintenance of CBCT machines, making them accessible to dental practitioners across the country.

The American Academy of Oral and Maxillofacial Radiology (AAOMR) emphasizes that dentists using CBCT should possess a comprehensive understanding of head and neck anatomy in radiographic images, including the ability to identify normal variants and diseases **[29]**.

Moreover, dental students in their preclinical years are advised to acquire fundamental knowledge and skills of clinical applications of CBCT across various dental disciplines. Postgraduates, on the other hand, are expected to use CBCT based on guidelines provided by the AAOMR, specific to each dental specialty. AAOMR emphasizes that CBCT procedures should be conducted solely by a well licensed physician or a certified radiologic operator. These examinations should be performed exclusively for effective diagnostic or treatment purposes, ensuring the minimum exposure necessary for an acceptable image quality **[29]**.

Despite the challenges and limitations inherent in survey-based research for assessing dentists' knowledge and attitudes towards CBCT, this method remains effective for evaluating educational programs in the short term. **[30]** To our knowledge, this is the first CBCT survey conducted among dentists in Afghanistan. However, Future research should also investigate the specific barriers to CBCT adoption in different regions of Afghanistan, such as logistical challenges, cost issues, and access to training resources. Understanding these regional variations will help tailor more effective strategies for improving CBCT integration into dental practice nationwide.

Limitations

This study has several limitations. Firstly, it relies on self-reported data from a questionnaire, which may introduce bias and is subject to recall inaccuracies. Additionally, the study's focus on dentists in Kabul may not fully represent the broader context of dental practice across Afghanistan. The omission of dental students from the survey also limits the understanding of CBCT awareness among future practitioners.

Conclusion

This study outlines the awareness and application of CBCT and digital imaging among Afghan dentists. Findings showed that faculty lessons playing a crucial role in developing CBCT knowledge amongst students compared to other resources. In addition, there was significant difference between GDPs and specialists regarding the CBCT awareness.

In conclusion, the responses from study participants emphasize the significance of CBCT in dentistry. Nonetheless, the study underscores the necessity for dental school curriculam to include thorough practical training in CBCT and integrate it with other clinical courses. Integrating CBCT training into the dental curriculumis essential for enhancing students' understanding and practical skills with this advanced technology.

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