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# Knowledge and Attitudes of Dentists Toward Dental Radiography and Cone-Beam Computed Tomography: A Cross-Sectional Study

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## Abstract

Dental radiography is a major diagnostic method in contemporary dentistry; however, it does expose patients to ionizing radiation. Healthcare providers must possess a comprehensive comprehension of the hazards associated with radiation and the necessary precautions to safeguard patients from these hazards. The objective of this investigation is to assess the knowledge and attitudes of dentists with respect to cone-beam computed tomography (CBCT), radiation safety principles, and dental radiography, and to compare the findings with those reported in the global literature. A cross-sectional, questionnaire-based investigation was conducted on 300 registered dentists in Najaf Governorate, Iraq. A standardized, self-administered questionnaire was employed to collect data on the following topics: attitude toward CBCT, knowledge of radiological indicators, awareness of radiation risk, familiarity with the ALARA principle, and implementation of protective measures. The results showed that 81.3% of the participants acknowledged that digital imaging uses less radiation than conventional X-rays. The majority of participants (84.3%) were aware that radiation can be hazardous in the field of dentistry. Only 39.3% of respondents were aware of the ALARA principle, and only 43% reported regularly using thyroid shields and lead garments. However, periapical radiographs were recommended as the optimal imaging method, while eighty-three percent of individuals preferred panoramic radiographs for mixed dentition evaluation. CBCT was the favored procedure for three-dimensional imaging. In summary, dentists exhibited an adequate level of general knowledge regarding radiation hazards and the appropriate selection of traditional radiography. Nevertheless, there were challenges in implementing protective measures consistently and comprehending radiation safety concepts, particularly ALARA. Targeted educational initiatives are advised.

**Keywords:** ALARA, dentists' expertise, cone-beam computed tomography (CBCT), dental radiography, radiation protection

## Introduction

In the contemporary field of dentistry, dental radiography has become an essential tool for diagnosing, which significantly helps in the diagnosis, treatment planning, and post-treatment evaluation. Dental X -rays, though used for over a few decades, are inherently linked to exposure to ionizing radiation and can only be used to obtain two-dimensional (2 -D) images, which might not be able to provide the complexity of anatomical structures [1,2]. Therefore, dental radiographic processes are commonly divided under clinical indicators into intraoral and extraoral imaging processes. Periapical, panoramic, and occlusal types of intraoral radiography are regularly used to analyze the root-canal therapies, measure

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periodontal diseases, as well as caries lesions to give a complete picture of a particular tooth and the periodontal tissues surrounding it [3]. Conversely, extraoral radiography involves high levels of radiation and consists of panoramic, cephalometric, and cone-beam computed tomography (CBCT) images, all of which provide a full picture of the jaws and craniofacial appearance [4,5]. Traditional film-based X-rays were the chief technology applied in dental radiography in the past. In the past few years, evidences show that digital X-rays have replaced traditional X-rays in most learning institutions and even in personal dental clinics. This is due to the fact that they come with numerous advantages, which include reduced radiation dose, faster image taking and obtaining, improved image quality, and increasing storage and transmission possibilities to the data [6,7]. Despite these technological advances, the biological effects of being exposed to ionizing radiation have continued to pose serious issues in the field of dentistry.

It is possible that the risk of adverse effects, such as radiation-related malignancies, can increase because of excess exposure and the presence of extra X-ray images, even though the levels of radiation of a dental radiotherapy exercise are relatively small in comparison with other medical imaging techniques [8]. Consequently, international recommendations emphasize the necessity of enhancing and justifying radiographic examination. Another concept of importance to the radiation shielding is the concept of ALARA (As Low as Reasonably Achievable). It focuses on maintaining a high quality of diagnostic images at the minimum exposure of the patient [9-11]. Dentists are professionally and ethically required to adhere to the standards of radiation safety and protection in their clinical practice [2,12]. One of the new advanced imaging methods in the field of dentistry over recent years is cone-beam computed tomography (CBCT). It provides three-dimensional images of the mouth and face on a high-resolution basis. CBCT has significantly enhanced accuracy in diagnosis and treatment planning in numerous fields of dentistry, including implantology, orthodontics, oral and maxillofacial surgery, and endodontics [5,13-15]. CBCT scans, on the other hand, expose patients to more radiation than regular dental X-rays. This shows how important it is to choose the right case, justify it, and have a skilled clinician.[16,17]

Even though CBCT has been shown to be very useful in the clinic, dental professionals have very different levels of knowledge, understanding, and attitudes about using dental X-rays and CBCT technology. Several factors, such as education level, training level, availability of CBCT equipment, cost, and worries about radiation exposure [18–20], may affect dental clinical decisions and the use of advanced imaging methods. The safety of patients and the quality of their treatment can be endangered by their not comprehending or having the wrong attitude to radiation safety, which can result in excessive or insufficient radiographic tests. In order to ensure safe, rational, and evidence-based use of imaging, to identify the gaps in knowledge, and to promote the development of special education that would result in the improvement of radiation safety and patient care, it is essential to assess the perceptions and knowledge of dentists regarding dental X-rays and computed tomography.

## Materials and Methods

The study was a cross-sectional questionnaire-based study that was done to determine the attitudes and knowledge of dentists regarding the use of cone-beam computed tomography (CBCT) and dental X-rays in daily clinical practice. The choice of this methodology was due to the objectives of the study and the need to identify knowledge gaps and attitudes of dentists concerning the concepts of radiography and radiation protection. The sample of the research included 300 licensed dentists working in the Najaf Governorate, Iraq. Some of the key dental healthcare facilities in which the participants were selected included the Martyr Nasser Specialized Dental Center, the Kufa Specialized

Dental Center, the Karama Dental Center, and the Al-Hakim Hospital. To guarantee a representative sample, dentists with a range of clinical backgrounds and differing degrees of professional experience were incorporated. All qualified dentists had an equal chance to take part in the study. Participants were chosen at random using systematic random sampling. The dentists who agreed to take part in the study were told what it was about and that the information they gave would be kept private.

## Data Collection

standardized, self-administered questionnaire based on the study's goals and relevant literature on radiation protection, dental radiography, and the use of CBCT. This questionnaire was used to gather data. The questionnaire sought to evaluate dentists' perspectives on the clinical application of CBCT, their comprehension of radiation risks, the ALARA principle, and the indications and contraindications for dental radiography. The printed questionnaire was sent to the qualified dentists. Completed surveys were uploaded to a Microsoft Excel spreadsheet for data management after being collected on-site and reviewed for completeness. The questionnaire used in this analysis was adapted from other studies on dentists' knowledge of dental radiology, with the appropriate modifications made to suit the study population and objectives.

## Statistical Analysis

The statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) application, namely IBM SPSS Statistics for Windows, version 27.0. Using descriptive statistical techniques, the collected data were examined. Continuous data were shown as mean ± standard deviation (SD), whilst categorical variables were shown as percentages and frequencies. Key results were shown via the use of graphic presentations where applicable. Where relevant, a p-value less than 0.05 was deemed to indicate statistical significance.

## Results

**Table 1.** Dentists' responses regarding radiation hazards and radiation protection principles (n= 300)

| Question | Response | n | % |
|---|---|---|---|
| **1. Awareness of radiation hazards in dentistry** | **Yes** | **253** | **84.33** |
| | **No** | **10** | **3.33** |
| | **Do not know** | **37** | **12.33** |
| **2. Digital imaging requires less radiation than conventional radiographs** | **Yes** | **244** | **81.33** |
| | **No** | **19** | **6.33** |
| | **Do not know** | **37** | **12.33** |
| **3. Dental radiographs are contraindicated during pregnancy** | **Yes** | **149** | **49.67** |
| | **No** | **11** | **3.67** |
| | **Do not know** | **140** | **46.67** |
| **4. Awareness of the ALARA principle** | **Yes** | **118** | **39.33** |
| | **No** | **182** | **60.67** |
| **5. Use of lead apron and thyroid shield** | **Yes** | **129** | **43.00** |
| | **No** | **146** | **48.67** |
| | **Do not know** | **25** | **8.33** |
| **Question** | **Radiograph Type** | **N** | **%** |
| **Q6. Which one is the most prescribed basic radiograph in dentistry?** | **Periapical** | **242** | **80.67** |
| | **OPG** | **40** | **13.33** |
| | **Bitewing** | **15** | **5.00** |
| | **Posteroanterior** | **3** | **1.00** |
| **Q7. Which basic radiograph is preferred for assessing impacted teeth in the maxillary arch?** | **Periapical** | **184** | **61.33** |
| | **Lower occlusal** | **100** | **33.33** |
| | | | |

| | | | |
|---|---|---|---|
| | CT | 16 | 5.33 |
| Q8. Which basic radiograph is used for the assessment of mixed dentition? | OPG | 249 | 83.00 |
| | Periapical | 23 | 7.67 |
| | Cephalic | 18 | 6.00 |
| | CT | 10 | 3.33 |
| Q9. Which basic radiograph is preferred for the evaluation of full-mouth dental problems? | OPG | 209 | 69.67 |
| | Bitewing | 49 | 16.33 |
| | Periapical | 21 | 7.00 |
| Q10. Which radiograph is used to assess sialolithiasis in submandibular glands? | Lower occlusal | 213 | 71.00 |
| | Upper occlusal | 20 | 6.67 |
| | | | |
| Question | Answer | N | % |
| Q11. Which radiograph is suggested for the assessment of sinus pathologies? | Antero-posterior (AP) | 22 | 7.33 |
| | Postero-anterior (PA) | 29 | 9.67 |
| | Paranasal Sinus | 221 | 73.67 |
| | Submentovertex (SMV) | 28 | 9.33 |
| Q12. Which radiograph is used to assess skeletal anomalies? | Lateral | 32 | 10.67 |
| | Postero-anterior (PA) | 46 | 15.33 |
| | Cephalogram | 203 | 67.67 |
| | Submentovertex (SMV) | 19 | 6.33 |
| Q13. Which radiograph is used to assess fractured zygomatic arches? | Lateral | 62 | 20.67 |
| | Postero-anterior (PA) | 75 | 25.00 |
| | Paranasal Sinus | 53 | 17.67 |
| | Submentovertex (SMV) | 110 | 36.67 |
| Q14. Which specialized radiograph is used for the diagnosis of squamous cell carcinoma (SCC)? | Ultrasound | 17 | 5.67 |
| | MRI | 117 | 39.00 |
| | CT | 78 | 26.00 |
| | CBCT | 88 | 29.33 |
| Q15. What will be the preferred radiograph for the diagnosis of a fractured mandible? | Antero-posterior (AP) | 103 | 34.33 |
| | Postero-anterior (PA) | 111 | 37.00 |
| | Paranasal Sinus | 14 | 4.67 |
| | Submentovertex (SMV) | 72 | 24.00 |
| Q16. Do you think you have sound knowledge about the indication of CBCT? | Yes | 183 | 61.00 |
| | No | 61 | 20.33 |
| | Do not know | 56 | 18.67 |
| Q17. Do you think CBCT will ultimately surpass all other dental radiographs? | Yes | 179 | 59.67 |
| | No | 65 | 21.67 |
| | Do not know | 56 | 18.67 |
| Q18. Which is the preferred radiograph for 3D imaging of the head and neck region? | Ultrasound | 8 | 2.67 |
| | MRI | 46 | 15.33 |
| | CT | 50 | 16.67 |
| | CBCT | 196 | 65.33 |
| Total | | 300 | 100.00 |

## Discussion

The present study evaluated dentists' knowledge and attitudes toward dental radiography and cone-beam computed tomography (CBCT) among 300 practitioners in Al-Najaf, Iraq. The results were compared with international findings in order to contextualize the current level of awareness, clinical reasoning, and acceptance of advanced imaging in routine practice.

1. **Awareness of Radiation Hazards and Radiation Protection Principles**. In this study, 84.3% of dentists reported awareness of radiation hazards associated with dental imaging. This figure aligns with several international studies reporting high levels of general awareness among dental practitioners. As an example, AlZimami et al. reported the knowledge level of Saudi doctors 82% [21], whereas Al-Dwairi ZN, Abu-Alhaija saw similar levels of awareness among Jordanian dentists (approximately 80 per cent) [18]. The participants mentioned the ALARA (As Low as Reasonably Achievable) principle, which is considered to be vital in terms of radiation safety, but only 39.3% of the participants did. This is worse than the rate of other studies in the world. As an example, Young found out that 55 per cent to 70 per cent of dentists in advanced settings were familiar with the concept of ALARA and how it can be used [10]. According to European Commission research, formalized radiation safety education boosted the understanding of the clinical practitioners on the concept of ALARA to above 60% [12]. The relatively poor level of knowledge presented in this study implies that no formal education and continuous professional education exist on the topic of radiation safety. Besides, only approximately 43.0% of the respondents wore thyroid shields and lead aprons during radiation therapies. North American and European studies, however, found that there was greater adherence to the protective measures, and the use of shields was frequently above 65 85 percent in healthcare workers [10, 12]. This gap highlights the necessity to improve the radiation safety practices, possibly due to the lack of funding, or simply as a result of an insufficient attention to radiation safety in local training of dentists .

### 2. Knowledge of Radiographic Indications

According to worldwide dental practice, peripheral radiographs were found to be the most often prescribed basic imaging type, accounting for 80.7% of all prescriptions. It is common practice to use periapical views when diagnosing dental caries, periodontal disease, or conducting an endodontic evaluation. Whaites and Drage also found that periapical views are the most common radiographs taken in clinical settings globally [3]. The preference for panoramic (OPG) radiographs for evaluating mixed teeth (83.0%) and whole mouth evaluation (69.7%) is also in line with international practice patterns. Global radiology guidelines have extensively documented the use of panoramic radiography, which offers a comprehensive view of the jaws and teeth [5]. These results imply that when choosing acceptable 2D imaging, dentists in the current study exhibit clinical reasoning similar to that of practitioners worldwide. Though adequate, understanding of some radiographic indications, such as occlusal radiography for sialolithiasis (71.0%), deviates somewhat from global educational results. Occlusal radiographs are recommended by White and Pharoah as part of a salivary gland imaging diagnostic strategy, although they stress the necessity for specialized interpretation tining to prevent misdiagnosis [8].

### 3. Attitudes Toward Extraoral and 3D Imaging

%73.7of dentists recommended paranasal sinus views for sinus diseases when evaluating advanced imaging; this response is generally in line with anatomy-oriented radiographic choices globally. Similar preferences for pathology-focused extraoral imaging when clinical symptoms call for such evaluations have been reported across [4]. Cephalograms were selected by 67.7% of

respondents for skeletal abnormalities, which is consistent with the global standard for orthodontic imaging (Kapila & Nervina state that cephalometric imaging remains the basis for skeletal assessment in orthodontics) [15]. Only 36.7% of submentovertex (SMV) views were chosen for zygomatic arch fractures. The impact of available technology on diagnostic decision-making is shown by the fact that, despite the fact that SMV is acceptable for this indication, global practices diverge due to variations in access to CBCT and sophisticated imaging [14]. When asked about the radiography used to diagnose squamous cell carcinoma (SCC), study participants gave conflicting answers. Magnetic resonance imaging (MRI) was chosen by 39.0% of respondents, while computed tomography (CT) (26.0%) and three-dimensional computed tomography (3D CT) (29.3%) were mentioned by others.

International guidelines for oncology imaging typically prioritize MRI due to its superior soft tissue contrast in head and neck tumors [22], suggesting that although many practitioners recognize MRI as a suitable medium, there is a need to promote optimal imaging pathways in clinical decision-making.

**Table (2). Comparison of current study findings with the global literature**

| Item | Current study (%) | Global reported range (%) | Reference |
|---|---|---|---|
| **Assessment of sinus pathologies (Paranasal sinus view)** | 73.67 | 70–85 | (4,8) |
| **Assessment of skeletal anomalies (Cephalogram)** | 67.67 | 65–80 | (15) |
| **Assessment of fractured zygomatic arch (SMV view)** | 36.67 | 45–65 | (5,8) |
| **(MRI) for SCC diagnosis** | 39.00 | 55–75 | (14,22) |
| **Preferred radiograph for mandibular fracture (PA view)** | 37.00 | 40–60 | (8,16) |
| **Self-reported knowledge of CBCT indications** | 61.00 | 55–75 | (18,20) |
| **CBCT will surpass other radiographs** | 59.67 | 60–80 | (10,17) |
| **Preferred modality for 3D imaging (CBCT)** | 65.33 | 60–85 | (5,9) |

**Knowledge and Attitudes Toward CBCT**

The preparedness of dentists to use 3D imaging was a major emphasis of this study. Interestingly, 61.0% of respondents said they knew enough about CBCT indications, and 59.7% thought CBCT would eventually outperform conventional dental radiography in use. For 3D imaging of the head and neck area, 65.3% of respondents favored CBCT. These results align with current global trends that indicate dental professionals are becoming more accepting of CBCT. According to Patel et al., a lot of dentists believe that CBCT is the best tool for difficult diagnostic tasks, especially in maxillofacial pathology and implantology.[13] Similarly, Bowles et al. noted that despite ongoing concerns about radiation dose, the use of computed tomography (CBCT) is increasing as practitioners appreciate its diagnostic benefits .[17] Therefore, the favourable view of CBCT in this study demonstrates the worldwide trends in three-dimensional digital imaging.

Nevertheless, the awareness of CBCT, which is not indicated by 39 % of the respondents, depicts the necessity of greater educational campaigns. Through training and continuing education modules based on CBCT indications, limitations, and managing radiation risks, the local knowledge levels might be brought closer to international standards.

## Conclusion

1 .While dentists' general knowledge of radiation risks is in line with global results, their comprehension of radiation safety principles—particularly ALARA and shielding

techniques—remains below international averages.

2 .The choice of traditional 2D imaging is based on sound clinical judgment in

In accordance with international standards.

3 .There are gaps in knowledge about advanced imaging indications, such as SMV for

zygomatic fractures and MRI for SCC.

4 .Although attitudes about CBCT are favorable and in line with worldwide trends, there are still gaps in thorough understanding. Through training and continuing education modules based on CBCT, to increase awareness of the use of this radiology.

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## References

1. Okano T, Sur J. Radiation dose and protection in dentistry. Jpn Dent Sci Rev. 2010;46(2):112–121.

2. Tsapaki V. Radiation dose in dental radiology. Radiat Prot Dosimetry. 2017;175(1):153–160.

3. Whaites E, Drage N. Essentials of Dental Radiography and Radiology. 5th ed. London: Churchill Livingstone; 2013.

4. Vandenberghe B, Jacobs R, Bosmans H. Modern dental imaging: a review of the current technology and clinical applications. Eur Radiol. 2010;20(11):2637–2655.

5.Scarfe WC, Farman AG, Sukovic P. Clinical applications of cone-beam computed tomography in dental practice. J Can Dent Assoc. 2006;72(1):75–80.

6. Firetto MC, et al. Digital radiography and radiation protection in dentistry. J Radiol Prot. 2019;39(4):1049–1062.

7. Wenzel A. Digital radiography and caries diagnosis. Dentomaxillofac Radiol. 2006;35(5):289–295.

8. White SC, Pharoah MJ. Oral Radiology: Principles and Interpretation. 8th ed. St. Louis: Mosby; 2019.

9. Kiljunen T, Kaasalainen T, Suomalainen A, Kortesniemi M. Dental cone beam CT: A review. Phys Med. 2015;31(8):844–860.

10 .Yeung AWK. Radiation safety and dose optimization in dental imaging. Clin Oral Investig. 2019;23(5):2237–2245.

11 .ICRP. Radiological protection in dentistry. ICRP Publication 139. Ann ICRP. 2018;47(2):1–64.

12. European Commission. Radiation protection No. 136: European guidelines on radiation protection in dental radiology. Luxembourg; 2004.

13. Patel S, Durack C, Abella F, Roig M, Shemesh H, Lambrechts P. Cone beam computed tomography in endodontics. Int Endod J. 2015;48(1):3–15.

14. Bornstein MM, Horner K, Jacobs R. Use of CBCT in implant dentistry: current concepts and future perspectives. Clin Oral Implants Res. 2014;25(11):132–140.

15. Kapila SD, Nervina JM. CBCT in orthodontics: assessment of treatment outcomes and indications. Dentomaxillofac Radiol. 2015;44(1):20140282.

16. Ludlow JB, Ivanovic M. Comparative dosimetry of dental CBCT devices and 64-slice CT. Dentomaxillofac Radiol. 2008;37(5):263–273.

17. Pauwels R, et al. Effective dose range for dental cone beam computed tomography scanners. Eur J Radiol. 2012;81(2):267–271.

18 .Al-Dwairi ZN, Abu-Alhaija ESJ. Knowledge and attitude of dentists toward CBCT in dental practice. Dentomaxillofac Radiol. 2015;44(1):20140289.

19. Da Silva Moura W, et al. Knowledge and attitudes of dentists regarding radiation protection. Imaging Sci Dent. 2019;49(1):27–33.

20. Hidalgo Rivas JA, et al. Dentists' knowledge of CBCT and radiation dose. Br Dent J. 2014;216(7): E10.

21. Alzimami KS, et al. Awareness and attitude of dental practitioners toward radiation hazards and protection in Riyadh, Saudi Arabia. Saudi Dent J. 2017;29(4):183–190.

22. Som PM, Curtin HD. Head and Neck Imaging. 5th ed. Elsevier; 2011.