Original Article

A survey of cone-beam computed tomographic use among Iranian endodontists

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Abstract

Objective: Cone beam computed tomography (CBCT) is an imaging modality that has recently gained increasing popularity for dental imaging. This study aimed to investigate the usage of CBCT imaging among Iranian Association of Endodontists members using an online survey.

Methods: Iranian endodontic practitioners were recruited to participate in the study. A web-based questionnaire was designed and sent to 328 endodontists. The questionnaire was available for a one-month long period during November 2019. The questionnaire included basic demographic details of the participants and questions related to CBCT application in endodontic treatment procedures. The validity and reliability of the questionnaire were assessed by expert endodontists. The chi-square test was used for data analysis, and a p-value less than 0.05 was considered statistically significant.

Results: A total of 101 participants completed the survey, giving an overall completed response rate of 30.8%. Ninety-four percent of participants (n=95) used CBCT imaging in their practice. There were significant differences in some variables between endodontists who frequently prescribed CBCT as compared to those who rarely prescribed it ($P<0.05$). CBCT was prescribed more frequently by endodontists who received training in CBCT usage, those performing periapical surgeries, and those using magnification in their practice.

Conclusions: The survey indicated that CBCT technology is widely used among Iranian endodontists particularly if they have already received the required training. The most common indications for CBCT were detecting vertical root fracture, teeth with complex anatomy and additional canals, and root resorption.

Keywords: Computer-assisted, Cone-beam computed tomography, Dental imaging, Endodontics, Guideline, Radiographic image interpretation

Introduction

Appropriate clinical evaluations and imaging techniques are crucial for effective endodontic case management (1). While traditional periapical radiography is often preferred for diagnosing pulpal and periapical conditions, its limitations like 2D representation, interference from surrounding anatomy, and potential distortions can impact its precision (2).

Cone-beam computed tomography (CBCT) offers a detailed 3D visualization of the desired area, potentially addressing the shortcomings of 2D images in several endodontic contexts (3). Endodontic applications of CBCT include the identification of root canal anatomy, detection of internal, external, cervical, and apical resorptions, localization of missed canals, separated instruments, and other foreign body materials before retreatment, identification of the extent of apical periodontitis, diagnosis of endodontic or nonodontogenic diseases, detection of root and alveolar fractures, and planning surgical endodontic treatments (3-5). Multiple research efforts have highlighted the enhanced precision and specificity of CBCT in identifying endodontic structures compared to traditional periapical or full-mouth X-rays (6-8).

However, like all technological advancements, CBCT has its challenges, including a potential increase in the radiation dosage to the patient. Thus, the anticipated advantage from CBCT should be substantial to warrant its application, keeping in mind the heightened radiation concerns (9). Several studies have explored the adoption and application of CBCT across various dental specialties such as oral surgeons, orthodontists, and of

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course, endodontists (10-12). This study aimed to investigate the acceptance and usage of CBCT imaging among members of the Iranian Association of Endodontists using an online survey.

The following research questions (RQs) were addressed:

• RQ 1 What percentage of Iranian endodontists prescribe CBCT?

• RQ 2 Is there any association between the training regarding the use of CBCT and the frequency of CBCT application?

• RQ 3 Is there any association between the performance of periapical surgery and the frequency of CBCT application?

RQ 4 Does the use of magnification influence the frequency of CBCT application?

Materials and Methods

The protocol of this cross-sectional study was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (IR.MUMS.DENTISTRY. REC.1398.083).
The study aimed to assess the self-reported application of CBCT among Iranian endodontists. A questionnaire was developed by two endodontists and a Ph.D. of Dental Public Health, according to the American Association of Endodontists (AAE) and American Academy of Oral and Maxillofacial Radiology (AAOMR) Joint Position Statement about the use of cone beam computed tomography in Endodontics (13). After designing the initial draft of the questionnaire and modifying the questions, an expert panel consisting of 11 endodontists was formed to assess the face validity and content validity of the questionnaire, by measuring the content validity index (CVI) and content validity ratio (CVR). The expert panel members were requested to specify whether each item was “relevant”, “clear”, and “simple” (CVI test), and also if it was “essential”, “useful but not essential”, or “not necessary” (CVR test). To do so, the experts were requested to score each item of the questionnaire from 1 to 4, indicating the degree of relevance, clarity, and simplicity: 1 (strongly disagree), 2 (disagree), 3 (agree), or 4 (strongly agree). Additionally, the members were asked to rank each item from 1 to 3 depending on the degree of its necessity: 1 (not necessary), 2 (useful but not essential), or 3 (essential). In calculating the item-level-CVI test (I-CVI), an approved item had a score of 3 or 4 from all expert panel members. The content validity ratio was calculated as 0.73, which is acceptable since it exceeds the minimum threshold value of 0.5.

The final version of the questionnaire (Table 1) was sent to 20 endodontists to assess its reliability. The survey consisted of 11 questions on 2 main topics:

• Demographic data: Age, gender, years of professional experience

• General approach to CBCT

A link to the online survey was sent to 328 members of the Iranian Association of Endodontists (IAE) through social media platforms. The survey was administered over 4 weeks in November 2019 in Iran. To encourage respondents to answer all questions, an error message was delivered if questions were left unanswered. Participants were informed that the survey was an academic research project and that the anonymity of participants was assured. A reminder was sent to the group of IAE after 2 weeks, to increase the response rate.

Finally, a total of 101 questionnaires were available for analysis. Statistical analyses were performed using SPSS software (version 16; SPSS Inc., Chicago, IL, USA) and data was presented according to descriptive statistics, including frequencies (n) and percentages (%). A chi-square test was performed to assess the association between some questions and the reported use of CBCT. The level of significance was set at 0.05.

Results

A total of 101 participants completed the online survey, resulting in an overall response rate of 30.8%.

Overall, 57.4% and 42.6% of the subjects were male and female endodontists, respectively. The mean age of the endodontists who participated in this study was 39.94 ± 7.30 (range: 27-67 years). About 53.5% of the participants had 10-19 years of professional experience, while 30.7% had 1-9 years and 15.8% had over 20 years of experience.

Approximately 94% (n = 95) of the respondents used CBCT imaging as part of their endodontic treatment. 38.6% (n =39) of practitioners used CBCT imaging ‘‘frequently’’ and 55.4% (n =56) used it "rarely”.

The three most common indications for CBCT application in descending order of frequency were: detecting vertical root fractures (VRF) (85.3%), teeth with complex anatomy and additional canals (70.5%), and root resorption (65.3%).

Table 1. The questionnaire to assess the CBCT application among endodontists

1. Age:
2. Gender:
3. Years of professional experience - 1-9 years - 10-19 years - ≥20 years
4. Do you use CBCT in your practice? Yes, frequently Yes, but rarely No If your answer is "NO", please go to the next question. If your answer is "YES", for which procedure? - Initial treatment of teeth with the potential for extra canals and suspected complex morphology - Initial treatment of teeth with the potential of calcified canals - For intra-appointment identification and localization of calcified canals if a preoperative CBCT has not been taken. - In cases of suspected vertical root fracture, if clinical examination and 2-D intraoral radiography are inconclusive - Evaluating the nonhealing appearance of previous endodontic treatment - Presurgical treatment planning - Diagnosis and management of limited dentoalveolar trauma, root fractures, luxation, and/or displacement of teeth, and localized alveolar fractures - Localization and differentiation of external and internal resorptive defects
5. Please specify the reasons for not using CBCT - High expenses - Insufficient training - Not necessary for endodontic treatment - Unavailability of a dental imaging center
6. Have you received training on the application of CBCT technology? Yes No If your answer is "YES", through which method of training? - undergraduate dental education - post-graduate endodontics education - workshops
7. Are you familiar with the instructions regarding using CBCT in Endodontics? Yes No
8. How do you interpret CBCT? - I use the reports provided by the oral and maxillofacial radiologist - I interpret the scans myself
9. Do you define the field of view (FOV) when prescribing a CBCT? Yes No
10. Do you use magnification in your clinical practice? Yes No
11. Do you perform endodontic surgery? Yes No

Regarding the reason behind the hesitation to use CBCT technology, 33.9% of respondents stated high costs to be the main reason. Other reasons cited included the unavailability of a dental imaging center (37.1%), no need for CBCT (17.7%), and the lack of CBCT training (11.3%).

Almost two-thirds (66.33%, n =67) of participants stated that they were trained to use CBCT in endodontic treatment. The most common educational method used was through specialized endodontic courses (n=26) and CBCT workshops (n=20). Endodontists who completed educational courses demonstrated a significantly higher frequency of CBCT utilization compared to their counterparts who had not undergone the same training (p=0.030).

Out of the total participants, 47.5% (n=48) showed familiarity with the published guidelines about the prescription of CBCT in endodontic treatments. Notably, this group prescribed CBCT significantly more often than those who were not familiar with the guidelines (p=0.010).

The interpretation of CBCT scans provided by the OMFR alone was used by just 11.6% of the respondents. About 71.6% (n =68) of the practitioners determined the field of view (FOV) for the oral and maxillofacial radiologist (OMFR).

Among the practitioners surveyed, 38.6% (n=39) utilized magnification in their procedures. It was observed that this subset of practitioners prescribed CBCT with a significantly higher frequency than those who did not employ magnification (p<0.001).

CBCT was ordered more frequently by 40.6% (n=41) of endodontists who performed periapical surgery than

those who did not perform this treatment procedure (p = 0.018).

Discussion

The present study was the first to assess the self-reported application of CBCT among Iranian endodontic specialists. According to the findings of this survey, a vast majority of endodontists (specifically 94%), incorporated CBCT examinations into their clinical practice. In comparison, other surveys conducted in the United States have reported a similar utilization rate of 91.8% among endodontists (14).

In this study, 71.6% of the respondents reported using CBCT technology with a limited Field of View (FOV). A similar proportion of participants (62.1%) in another survey conducted among endodontic practitioners in Germany and Switzerland also specified the size of the FOV they utilized (15). The optimal FOV for patients can be selected, based on their individual (therapeutic) requirements (16). According to Moshiri et al (17), since one tooth is afflicted in endodontics, FOV may be small or concentrated (5 cm × 5 cm or less), which can be an advantage for CBCT imaging. The results of Setzer et al. (18) also indicate that limited or small FOV in CBCT will significantly reduce radiation exposure. With limiting the FOV, the images are prepared with minimal radiation dose and high resolution (19).

In this survey, only a few endodontists (11.6%) would solely rely on the radiologist's report for interpreting the obtained CBCT scans, and 28.6% of endodontists would rely only on their interpretation. With the increasing use of CBCT, training in the interpretation of scans and coordination of these training courses for OMFRs and endodontists should be addressed.

According to the findings of the present study, there was a significant correlation between CBCT knowledge and the frequency of CBCT use. Among the participants prescribing CBCT, 66.3% had already been trained; mainly through postgraduate endodontic courses (25.7%), and CBCT workshops (19.8%). According to Yalcinkaya, et al. (20), most of the participants were familiar with CBCT, through continuing education (CE) courses and programs; this finding indicates the importance of training programs, and our survey also reveals these CE courses to be effective. Webinar lectures, scientific textbooks, and scholarly journals have also been reported to be effective resources for promoting dentists' knowledge regarding dental anatomy in CBCT imaging (21).

The results of the present study showed that familiarity with the guidelines regarding the use of CBCT had a significant effect on CBCT application (P<0.001). Approximately 52% of the participants were not familiar with the international guidelines and statements regarding the application of CBCT in endodontics. Therefore, it is essential to organize CE programs to ensure that endodontists are familiar with the guidelines and their regular updates. This is especially crucial when developing a training plan.

In this investigation, the primary reason for hesitation in prescribing CBCT examinations was identified as the high cost associated with this technique. Similar findings were reported by Ghoncheh et al., who also highlighted the high cost as the main obstacle for dentists in prescribing CBCT (22). Despite the higher expense of CBCT imaging compared to 2D radiography, research has demonstrated that 2D radiography may not be sufficient in many cases. In contrast, CBCT technology offers supplementary information that cannot be obtained through conventional 2D radiography (23,24).

This survey found that practitioners who used magnification in their practice more frequently referred patients for CBCT. This may be because they are more likely to treat complex cases. Furthermore, CBCT was used more often by endodontists who performed periapical surgery. Alzamzami et al (14) also reported that the majority of endodontists prescribed CBCT for cases requiring periapical surgery.

In the current study, the most commonly prescribed CBCT cases comprised three main categories: those suspected of having a vertical endodontic fracture (85.3%), dental treatments with suspected complex anatomy and extra canal (70.5%), and cases involving internal and external root resorption (65.3%). Similarly, a clinical study demonstrated that CBCT exhibited high sensitivity and specificity in the definitive diagnosis of vertical endodontic fractures, with sensitivity and specificity rates of 88% and 75%, respectively, at the time of surgery (25). Some experimental and *in vivo* studies also confirmed these findings (26, 27). The AAE and AAOMR Joint Position Statement about the use of CBCT also states that if a clinical examination and two-dimensional (2D) radiography do not lead to a definite diagnosis for a vertical endodontic fracture, CBCT shall be selected as an imaging technique. In addition, CBCT application has been introduced as a selective technique for the endodontic treatment of teeth with complex anatomy and extra canals, such as mandibular incisors, and maxillary and mandibular premolars, as well as the diagnosis of internal and external root resorption (13).

Similar to other questionnaire-based research, this study also faced certain limitations. One potential limitation is the possibility of participants not returning the questionnaire. Additionally, respondents may encounter difficulties in understanding the concepts and content of the questions, leading to confusion and potential inaccuracies in their responses. Sometimes, conflicting information obtained through this method could pose challenges in the interpretation of the results. It is recommended to organize courses and workshops to enhance practitioners' proficiency in this technology. Moreover, extending insurance coverage for this type of imaging can increase its usage, ultimately leading to improved treatment processes.

Conclusions

This survey showed that there is already a widespread application of CBCT technology among Iranian endodontists particularly if they have already received the required training. The three most common indications for CBCT application in descending order of frequency were: detecting VRF, teeth with complex anatomy and additional canals, and root resorption. Several factors contribute to the underutilization of this radiography method. These factors include the lack of adequate training among practitioners, the high cost of radiography for patients, and the absence of insurance coverage for this specific imaging technique.

Conflict of Interest

The authors declare no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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