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# Evaluation of the Frequency and Reasons for Requesting Cone-Beam Computed Tomography by Endodontists in Turkey

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**ABSTRACT**

This study aimed to evaluate the frequency and reasons for requesting Cone-beam computed tomography (CBCT) by endodontists in Turkey. 213 endodontists in Turkey participated in this survey research. Participants were asked 12 questions regarding their age, gender, the year since they completed their endodontic specialization or doctorate, the institution they work, their title and CBCT use cases. The descriptive statistics of the data are presented as percentages and frequencies. The chi-square test was used for pairwise comparisons ($p<0.05$). The rate of participants using a CBCT evaluation in their diagnosis and treatment was 77.9%. 81.7% of participants reported that the frequency of CBCT requests was less than 20% compared to the monthly total number of patients treated. 27.7% of participants indicated that the reason for requesting CBCT was to evaluate root resorption, and 36.6% indicated that they needed CBCT most frequently in the maxillary anterior region. It was determined that the majority of the participants, whose frequency of CBCT request was below 20%, did not have sufficient knowledge about CBCT. The majority of study participants use CBCT in their clinical practice. Although most participants have CBCT in their facility, they indicated that they do not have enough information about the use of CBCT. Most participants indicated that the frequency of CBCT use was lower than the number of cases studied. The reasons for using CBCT were complications in resorption and retreatment cases where two-dimensional imaging was inadequate for diagnosis and treatment.

**Keywords:** Cone-beam computed tomography, diagnosis/treatment planning, endodontics, endodontist, survey

## Introduction

Panoramic and periapical radiographs are the most commonly used imaging modalities for diagnosis and treatment planning in endodontics. However, these imaging modalities have some limitations as they provide two-dimensional images (1). These limitations include an overlap of anatomical structures and geometric distortions such as distortion and magnification in the region of interest. Cone-beam computed tomography (CBCT) can overcome these limitations by providing three-dimensional images of the teeth and surrounding tissues (2). CBCT is an imaging system that allows digital visualization of the anatomical structures of the maxilla and mandible in different planes (axial, coronal, and sagittal). CBCT has been used to diagnose and treat complex endodontic problems with three-dimensional radiographic evaluation of the teeth and surrounding structures (3). CBCT is used in endodontics to evaluate pre-endodontic procedures, root canal anatomy, endodontic complications, tooth anatomy abnormalities, root resorptions, cases of dental trauma, and periapical pathologies (4).

In 2011, the American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiology (AAOMR) published a joint report on the use of CBCT in endodontics (5). They recommend clinicians to use CBCT in endodontics by comparing the diagnostic information available through screening with the risks of radiation exposure. They also report that CBCT should not be used routinely in every case and every patient and that the decision should be made after a detailed clinical examination (5).

Survey studies have been conducted regarding the use of CBCT in dentistry education in different

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areas of dentistry such as oral and maxillofacial surgery and orthodontics (6–8). When the literature was reviewed, limited number of survey studies were found on the use and frequency of CBCT in endodontics (9–11). However, no study investigated the use and frequency of CBCT by endodontists in Turkey. Therefore, this study aimed to investigate the frequency and reasons for using CBCT by endodontists in Turkey.

## Materials and Methods

**Sample Size:** The population of this study consists of endodontists in Turkey, and the sample consists of a total of 213 endodontists from different regions of Turkey. As a result of the power analysis performed to find the minimum value that our sample size should have in order to give meaningful results, it was found that power = 0.95 at the $\alpha = 0.05$ significance level and our minimum sample size should be 206. The sample size was calculated using G*Power 3.1 software (Heinrich Heine University).

**Ethical approval and Study Design:** Ethics committee approval was obtained for this study from Van Yüzüncü Yil University Non-Invasive Ethics Committee (2022/03-07). This study was conducted in accordance with the Declaration of Helsinki. Two hundred and thirteen endodontists in Turkey participated in this survey. Informed consent was obtained from the participants for this study. This study was conducted online and face-to-face. The questionnaire prepared via Google forms was emailed to the endodontists in Turkey through the Turkish Endodontic Society, and a period of one month was given for participants to complete the survey. Some of the forms were filled out in person because there were not enough responses after one month. Each participant completed the form only once.

Participants were asked 12 questions regarding their age, gender, the year since they completed their endodontic specialization or doctorate, the institution they work, their title, whether there is CBCT evaluation in the institution they work, whether they use CBCT evaluation in their diagnosis and treatment, the frequency of requesting CBCT compared with the total number of patients examined per month, the most common reason for requesting CBCT, where they received training in CBCT evaluation, whether they have sufficient knowledge of CBCT evaluation, and in which dental region they needed CBCT the most. The survey form prepared to ensure the validity of the measurement tool used was examined by 3 endodontic specialists and 2 statistics and data analysis experts, and then the measurement tool was given its final form. The questions asked of the participants are shown in Figure 1.

**Statistical Analysis:** The SPSS statistical program (IBM version 23.0; SPSS Inc., Chicago, Illinois, USA) was used to analyze the data obtained. The descriptive statistics of the data are presented as frequencies and percentages. Chi-square test was used for pairwise comparisons of the questions in Table 4. The statistical significance level was accepted as $p<0.05$.

## Results

The mean age of participants in the survey was 30.64 (22-59). 35.2% of the participants were female, and 64.8% were male. The percentage tables for the questions 'How many years has it been since you completed your specialization or doctorate, what is your most common reason for requesting a CBCT, where did you receive your training in CBCT evaluation, in which tooth region do you need CBCT most?' are shown in Table 1. The percentage tables for the questions 'What is your title, what is the percentage of frequency you request CBCT compared to the total number of patients treated per month, what institution do you work for' are shown in Table 2. The percentage tables for the questions 'Does your institution have a CBCT, do you use CBCT evaluation in your diagnosis and treatment, do you think you have sufficient knowledge about CBCT evaluation' are shown in Table 3. The percentage charts for the questions "What is your most common reason for requesting CBCT, where did you learn CBCT evaluation, in which dental area do you need CBCT the most" are shown in Figure 2, Figure 3 and Figure 4.

The results of the chi-square test, in which pairwise comparisons were performed, are shown in Table 4. A statistically significant relationship was found between "Do you use CBCT evaluation in your diagnosis and treatment" and "Does your institution have a CBCT" ($\chi^2$; 20.079, $p=0.000$). It was found that the majority of those who use CBCT have a CBCT in the facility where they work, while the majority of those who do not have a CBCT in their facility.

A statistically significant relationship was found between the question "What is the percentage of frequency you request a CBCT compared to the total number of patients screened monthly" and the question "Do you think you have adequate

**Table 1.** Descriptive Statistics Regarding The Last Year of Specialization or Doctoral Education, Reasons For Requesting CBCT, When They Received CBCT Training, and In Which Region They Needed CBCT

| How many years has it been since you completed your specialization or doctorate? | P (n) | What is your most common reason for requesting a CBCT? | P (n) | Where did you receive your training in CBCT evaluation? | P (n) | In which tooth region do you need CBCT most? | P (n) |
|---|---|---|---|---|---|---|---|
| Specialization/doctoral education continues | 49.8 (106) | Evaluation of root resorption (Internal and external root resorption) | 36.6 (59) | In specialization/doctoral training | 46.6 (95) | Maxillary anterior | 36.6 (78) |
| 0-5 | 35.7 (76) | Evaluation of complications during the retreatment | 19.7 (42) | I have never been received training | 22.4 (52) | Maxillary premolar | 1.4 (3) |
| 6-10 | 10.3 (22) | Evaluation of root canal anatomy and abnormalities (dens invaginatus, calcification) | 18.3 (39) | In undergraduate training | 16.4 (35) | Maxillary molar | 31 (66) |
| 11-15 | 1.9 (4) | Evaluation of periapical pathologies | 15.5 (33) | At scientific meetings such as congresses/symposia | 8 (17) | Mandibular anterior | 1.4 (3) |
| 16-20 | 0.9 (2) | Evaluation of dental trauma (horizontal or vertical root fractures) | 13.6 (29) | Articles/ journals/books | 5.2 (11) | Mandibular premolar | 6.1 (13) |
| >20 | 1.4 (3) | Evaluation prior to endodontic surgery | 5.2 (11) | Social media | 1.4 (3) | Mandibular molar | 23.5 (50) |

CBCT: Cone-beam computed tomography, P: Percentage (%), n: number

knowledge of CBCT evaluation" ($\chi^2$; 28.515, p=0.000). It was found that the majority of respondents with a frequency of CBCT requests of less than 20% did not have sufficient information about CBCT, and the majority of respondents with a frequency between 20-40% had sufficient information about CBCT.

A statistically significant association was found between "How many years has it been since you completed your specialization or doctorate" and "Do you think you have sufficient knowledge about CBCT" ($\chi^2$; 32.553, p=0.000). It was found that most of those who continue their specialization /doctoral education and those completed their specialization/doctorate education 0-5 years and 6-10 years ago did not have sufficient knowledge of CBCT. A statistically significant association was found between "Do you use CBCT evaluation in your diagnosis and treatment" and "Do you think you have sufficient knowledge of CBCT evaluation" ($\chi^2$; 16.065, p=0.000). It was found that both, those who use CBCT and those who do not, have sufficient information about CBCT. No statistically significant difference was detected in other pairwise comparisons (Table 4).

**Table 2.** Descriptive Statistics Regarding Title, Frequency of Requesting Cbct, and Institution of Employment

| What is your title? | P (n) | What is the percentage of frequency you request CBCT compared to the total number of patients treated per month? | P (n) | What institution do you work for? | P (n) |
|---|---|---|---|---|---|
| Specialization or doctoral student | 50.2(107) | <20% | 81.7(174) | Private hospitals and clinic | 6.1 (13) |
| Specialist or PhD | 31(66) | 20-40% | 11.7(25) | Public hospitals and oral health center | 28.2 (60) |
| Assistant professors | 13.1(28) | 40-60% | 2.3(5) | School of dentistry | 65.7 (140) |
| Associate professor | 3.3(7) | 60-80% | 1.4(3) | | |
| Professor | 2.4(5) | >80% | 2.8(6) | | |

CBCT: Cone-beam computed tomography, P: Percentage (%), n: number

**Table 3.** Descriptive Statistics Regarding The Presence of CBCT in the Institution Where We Work, the use of CBCT in Diagnosis and Treatment, and Sufficient Knowledge About CBCT

| Does your institution have a CBCT? | P (n) | Do you use CBCT evaluation in your diagnosis and treatment? | P (n) | Do you think you have sufficient knowledge about CBCT evaluation? | P (n) |
|---|---|---|---|---|---|
| Yes | 70.9(151) | Yes | 77.9(166) | Yes | 27.2(58) |
| No | 29.1(62) | No | 22.1(47) | No | 72.8(155) |

CBCT: Cone-beam computed tomography, P: Percentage (%), n: number

## Discussion

Compared to periapical radiographs, CBCT provided more accurate results in detecting extra canal anatomy, evaluating the quality of root canal fillings, evaluating periapical lesions, and detecting root resorption and root fractures (12–15). Due to the high accuracy of CBCT and the increasing availability of CBCT, it is now widely used. This study investigated how frequently and for what reasons endodontists in Turkey request CBCT.

According to the results of this study, 77.9% of the participants stated that they use CBCT evaluation in their diagnosis and treatment. Today, the European Society of Endodontology (ESE), the American Association of Endodontists (AAE), and the American Academy of Oral and Maxillofacial Radiology (AAOMR) recommend the use of CBCT in the diagnosis and treatment of endodontics, taking into account the benefit-harm ratio in limited FOV ranges when conflicting or nonspecific clinical signs and symptoms are detected (16).

81.7% of participants reported that the frequency of CBCT requests was less than 20% compared to the monthly total number of patients treated. The European Society of Endodontics recommended that CBCT be considered and used after a thorough clinical examination, including conventional radiographs, when periapical radiographs are inadequate. In addition, ESE reported that CBCT should be used for the identified indications after weighing the potential benefits and harms, not in every case (4). In addition, this study found that most of those who requested less than 20% of CBCT were not adequately informed about CBCT. In comparison, most of those between 20-40% were adequately informed about CBCT. The result of this study shows that the frequency of CBCT use is consistent with the information reported in the literature. However, one of the most important reasons for the low frequency of CBCT use is that participants are not sufficiently informed about CBCT.

According to the results of this study, it was found that the majority of those who used CBCT

**Table 4.** Statistical Pairwise Comparison Results

| Statistics | P* |
|---|---|
| 'Do you use CBCT evaluation in your diagnosis and treatment?' * 'Does your institution have a CBCT?' | 0.000 |
| 'Do you use CBCT evaluation in your diagnosis and treatment?' * 'Do you think you have sufficient knowledge about CBCT evaluation?' | 0.000 |
| 'How many years has it been since you completed your specialization or doctorate?' * 'Do you think you have sufficient knowledge about CBCT evaluation?' | 0.000 |
| 'What is the percentage of frequency you request CBCT compared to the total number of patients treated per month?' * 'Do you think you have sufficient knowledge about CBCT evaluation?' | 0.000 |
| 'Do you use CBCT evaluation in your diagnosis and treatment?' * 'What institution do you work for?' | 0.094 |
| 'How many years has it been since you completed your specialization or doctorate?' * 'Do you use CBCT evaluation in your diagnosis and treatment? | 0.354 |
| 'Does your institution have a CBCT?' * 'Do you think you have sufficient knowledge about CBCT evaluation?' | 0.705 |
| 'Does your institution have a CBCT?' * 'What is the percentage of frequency you request CBCT compared to the total number of patients treated per month?' | 0.162 |
| 'Does your institution have a CBCT?' * 'What is your most common reason for requesting a CBCT?' | 0.742 |
| 'How many years has it been since you completed your specialization or doctorate?' * 'What is your most common reason for requesting a CBCT?' | 0.293 |
| 'What is your title?' * 'What is your most common reason for requesting a CBCT?' | 0.327 |
| 'Do you think you have sufficient knowledge about CBCT evaluation?'* 'What is your most common reason for requesting a CBCT?' | 0.134 |

CBCT: Cone-beam computed tomography
*Chi-square test

had CBCT in their facility, while the majority of those who did not use CBCT did not have CBCT in their facility. As a result, physicians who have access to CBCT in their facility are better able to make desired adjustments to image and dose levels. In addition, the fact that CBCT imaging must be requested from another imaging center increases the cost to the patient and may cause physicians who do not have a CBCT at their facility to use CBCT less.

According to the survey results, the preferred reasons for requesting a CBCT were to assess root resorption (27.7%), to assess retreatment complications (19.7%), and to assess root canal anatomy and abnormalities (18.3%). According to the study's results on using CBCT among endodontists in Australia/New Zealand (11) and the USA (9) internal and external resorption cases were reported as the preferred area of use. The results of this study are consistent with the results of studies conducted on various populations in the literature. In addition, studies have reported that the use of CBCT provides more accurate results than periapical radiographs in the diagnosis of root resorption (17). Therefore, CBCT evaluation may have been commonly used to diagnose root resorption.

According to the results of this study, the most frequently required areas for CBCT were the anterior maxillary teeth (36.6%) and maxillary molars (31%). The central maxillary teeth have the most cases of external cervical root resorption (18), external apical root resorption (19, 20), and internal resorption (21). Therefore, the largest CBCT area may have been the anterior maxillary tooth. Studies have reported that the root canal system of maxillary molars is complex, and the proportion of four canals is high. It has also been reported that 46.5-59.5 of maxillary molars have untreated root canals (22). Due to the complex anatomy of maxillary molars and the high retreatment requirement, CBCT is one of the most preferred procedures.

46.6% of participants reported that they had received training in CBCT evaluation as part of their specialization training, 16.4% as part of their undergraduate training, and 22.4% had no

**Age**

.....

**Gender**

☐ Male
☐ Female

**How many years has it been since you completed your specialization or doctorate?**

☐ Specialization/doctoral education continues
☐ 0-5
☐ 6-10
☐ 11-15
☐ 16-20

**What institution do you work for?**

☐ Private hospitals and clinic
☐ Public hospitals and oral health center
☐ School of dentistry

**What is your title?**

☐ Specialization or doctoral student
☐ Specialist or PhD
☐ Assistant professors
☐ Associate professor
☐ Professor

**Does your institution have a CBCT?**

☐ Yes
☐ No

**Do you use CBCT evaluation in your diagnosis and treatment?**

☐ Yes
☐ No

**What is the percentage of frequency you request CBCT compared to the total number of patients treated per month?**

☐ <%20
☐ %20-40
☐ %40-60
☐ %60-80
☐ >%80

**What is your reason for requesting a CBCT?**

☐ Evaluation of root canal anatomy and abnormalities (dens invaginatus, calcification)
☐ Evaluation of complications during the retreatment (instrument fracture, perforation, insufficient or overfilling …)
☐ Evaluation of root resorption (Internal and external root resorption)
☐ Evaluation of dental trauma (horizontal or vertical root fractures)
☐ Evaluation of periapical pathologies
☐ Evaluation prior to endodontic surgery

**Where did you receive your training in CBCT evaluation?**

☐ I have never been received training
☐ In undergraduate training
☐ In specialization/doctoral training
☐ At scientific meetings such as congresses/symposia
☐ Articles/journals/books
☐ Social media
☐ Other (Please specify)

**Do you think you have sufficient knowledge about CBCT evaluation?**

☐ Yes
☐ No

**In which tooth region do you need CBCT most?**

☐ Maxillary anterior
☐ Maxillary premolar
☐ Maxillary molar
☐ Mandibular anterior
☐ Mandibular premolar
☐ Mandibular molar

**Fig. 1.** The questions asked of the participants

training. Furthermore, 72.8% of participants felt that they did not have sufficient knowledge of CBCT evaluation. These results show the lack of knowledge of endodontists about CBCT. We believe this is because the content of primary and specialization training for CBCT is insufficient. The European Endodontic Society has stated that all clinicians who use CBCT should have adequate and accredited training (4). It was also stated that CBCT-related education should be included in the curriculum of undergraduate and graduate programs in dentistry such as how to work, justify,

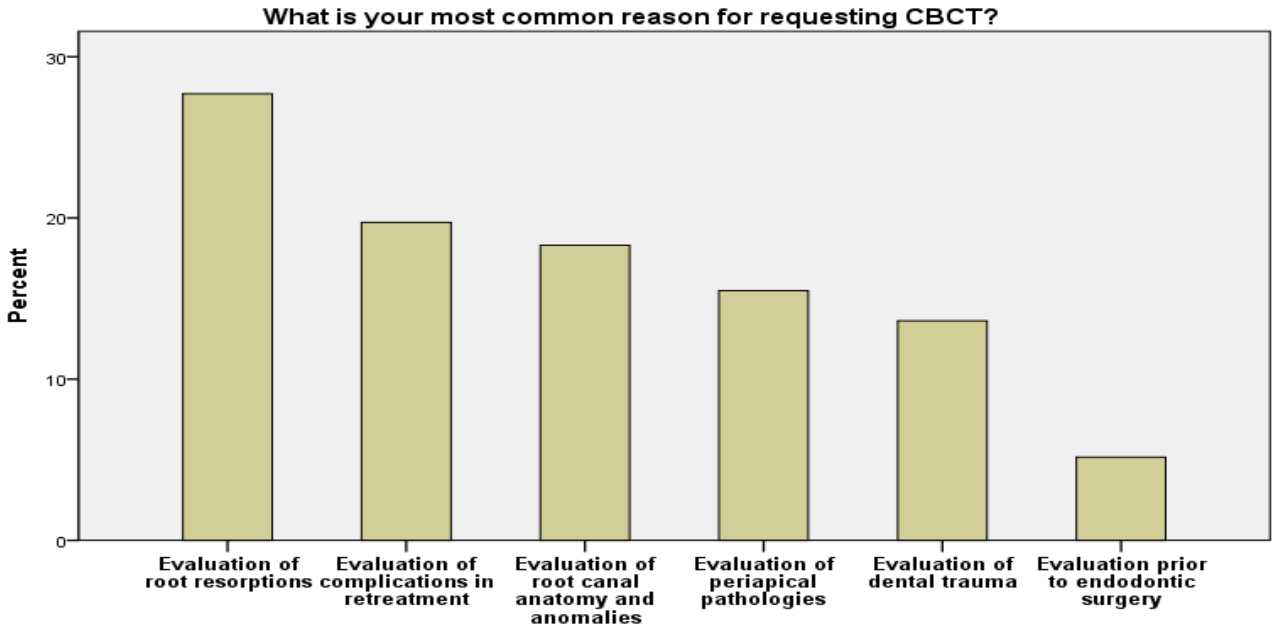


**Fıg. 2.** 'What is your most common reason for requesting a CBCT?' bar chart of percentages for questions

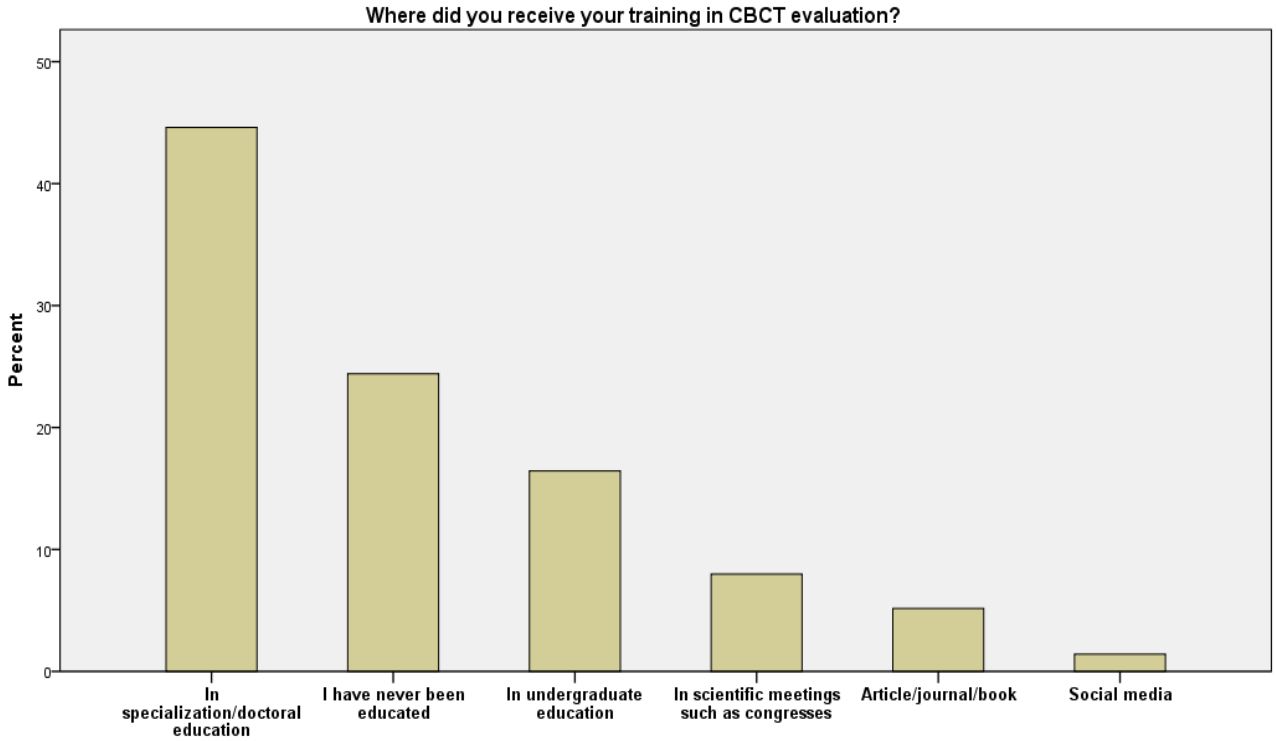


**Fig.3.** 'Where did you receive your training in CBCT evaluation?' bar chart of percentages for questions

interpret, and report CBCT images (4, 23). In addition, based on the results of this study, it was found that most of those who continue their specialization /doctoral education do not have sufficient knowledge of CBCT 0-5 years and 6-10 years after completing their specialization /doctoral training. These results indicate that the content of dental education in Turkey is insufficient and that CBCT should be explained in more detail, especially in specialization training.

The limitations of this study are that part of the questionnaire was applied online and partly face-to-face. In this study the online questionnaire form was sent via email through the Turkish Endodontics Association. However, not all endodontists in Turkey are members of the Turkish Endodontics Association. For this reason,

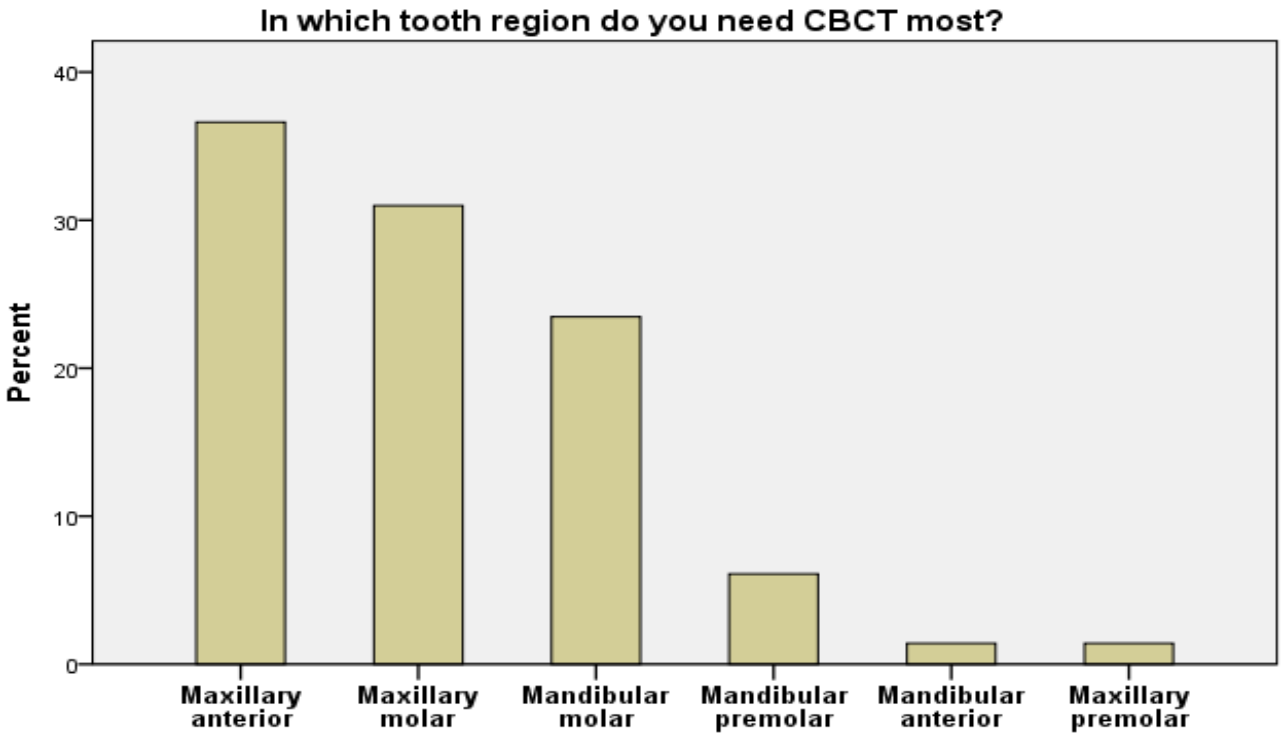


**Fig. 4.** 'In which tooth region do you need CBCT most?' bar chart of percentages for questions

part of the questionnaire was completed by face-to-face interviews in order to reach the sufficient number of participants and to ensure the reliability of the research.

Within this study's limitations, most study participants use CBCT in their clinical practice. Although most participants have CBCT in their facility, they indicated that they do not have enough information about the use of CBCT. Most participants indicated that the frequency of CBCT use was lower than the number of cases studied. The reasons for using CBCT were complications in resorption and retreatment cases where two-dimensional imaging was inadequate for diagnosis and treatment.

**Ethical Approval:** Ethics committee approval was obtained for this study from (2022/03-07).

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