

## Reasons of Request for Cone Beam Computed Tomography

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### Abstract

This retrospective study has aimed to examine the distribution of Cone Beam Computed Tomography (CBCT) request records in a dental faculty from 2011 to 2021 according to gender, diagnosis, the clinic making the request, and the year. In this study, archive records of 8214 CBCT images between January 2011 and January 2021 at Dicle University Faculty of Dentistry were examined. The findings showed that, in the last 10 years, the clinics requesting CBCT images were Oral, Dental, and Maxillofacial Surgery (48.6%), Orthodontics (20.4%), Oral, Dental and Maxillofacial Radiology (10.8%), Private Clinics (7.3%), Periodontology (4.3%), Pediatric Dentistry (2%) Endodontics (0.5%), and Restorative Dentistry (0.2%). CBCT was preferred for implant treatment planning (45.18%) and position of the embedded tooth (14.89%).

In the evaluation made on CBCT request records of 8214 patients, 20 different reasons for request were identified. It was observed that CBCT images were mostly requested for implant treatment planning in the Oral, Dental and Maxillofacial Surgery clinic and CBCT requests were seen to increase from 2011 to 2021.

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### Introduction

Cone beam computed tomography (CBCT) is small volume tomography, which was developed in the 1990s by reducing the radiation dose than computed tomography (CT). CBCT can provide a three-dimensional (3-D) image of the craniofacial region with a single revolution around the patient.<sup>1-3</sup> With the development of new models and a significant increase in the number of imaging units in the last 30 years, CBCT has become an imaging method widely used in diagnosis and treatment planning in all areas of dentistry.<sup>4</sup>

CBCT allows the examination of images obtained from the craniofacial region in multi-axial (axial, sagittal, coronal) directions without creating growth or deviation from reality.<sup>5-7</sup> As the CBCT data are applied on personal computers, the software enables the measurement of volume, angle, length and

density of bones in the craniofacial region by providing the physician with a task-oriented and real dimension analysis.<sup>5,8</sup>

It has been reported that CBCT can be used in many areas, such as the examination of teeth and surrounding structures in the maxillofacial region, the evaluation of embedded teeth, orthognathic surgery, examination of the temporomandibular joints, endodontics, dental implants and the application of bone grafts, cleft lip and palate, the determination of relationships between the teeth and the maxillary sinuses, postoperative evaluation of patients after treatment, and the evaluation of trauma, cysts or tumours in the dental or bony regions.<sup>2,6-8</sup>

Although the radiation dose of CBCT is lower than that of medical CT, it is higher than that of traditional two-dimensional dental radiographs.<sup>5,6,8,9</sup> In the most recent guidelines published by the American Oral and Maxillofacial Radiology Academy (AOMR) for the use of CBCT images in dental clinics, which are based on the ALARA principle (as low as reasonably achievable), it is recommended that clinicians should use CBCT wisely, considering the risk-benefit of radiation for additional diagnostic information.<sup>10,11</sup>

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This study aimed to evaluate the dentists' opinions on CBCT imaging, determine the reasons for the preference for CBCT imaging, and interpret these through examination of the CBCT requests of dentists according to clinic and year.

### Materials and methods

A retrospective examination was made of the archive records of 8214 CBCT images taken in the Department of Oral, Dental and Maxillofacial Radiology between January 2011 and January 2021. The examination was made of the clinics requesting the CBCT images obtained on the I-CAT 3G DVT device (Kavo Dental GmbH, Warthausen, Germany), the reason for the request, the year the request was made, and the patient age and gender.

The CBCT requests were made by clinics in the faculty and by private clinics. Tables were created showing patient gender, the department making the request, the diagnosis and the year the request was made according to the CBCT request records. The mean value ranges were determined.

Data obtained in the study were analyzed statistically using IBM SPSS vn. 21 software. variables were stated as numbers and percentages with frequency analysis. Pearson chi-square analysis was applied when examining the relationships between groups of nominal variables. In the interpretation of the results, a value of  $p < 0.05$  was accepted as statistically significant.

Approval for this study was granted by the Ethics Committee of the Dentistry Faculty of Dicle University (decision no: 2020-20).

### Results

The evaluation was made of the archived CBCT request records of 8214 patients, comprising 3875 (47.18%) males and 4339 (52.82%) females with a mean age of 36 years (4-90 years). There were 20 different reasons for the requests for CBCT images from private clinics and eight dental clinics in the university.

The distribution of age and gender of the patients for whom CBCT was requested is shown in Table 1.

Patients		N (%)
Gender	Female	4339 (52.82)
	Male	3875 (47.18)
		<b>Min - Max</b>
Age (years)	Female	4 - 86
	Male	5- 90

**Table 1.** Distribution of the age and gender of the patients for whom CBCT imaging was requested [n (%)].

Clinics requesting CBCT	N (%)
Oral, Dental and Maxillofacial Surgery	3991(48.6)
Ortodontics	1673 (20.4)
Oral, Dental and Maxillofacial Radiology	890 (10.8)
Prosthetic Dentistry	602 (7.3)
Private Clinics	480 (5.8)
Periodontology	356 (4.3)
Paediatric Dentistry	161 (2)
Endodontics	45 (0.5)
Restorative Dentistry	16 (0.2)
<b>Total</b>	<b>8214 (100)</b>

**Table 2.** The distribution of the clinics requesting CBCT images [n (%)].

The distribution of the clinics requesting CBCT images is shown in Table 2. The clinics requesting CBCT images were Oral, Dental, and Maxillofacial Surgery (48.6%). The initial diagnoses for CBCT imaging requests are shown in Table 3. It was seen that the requests for CBCT imaging for implant treatment planning at the rate of 45.18%.

The distribution of the CBCT images taken between January 2011 and January 2021 according to year is shown in Table 4. When examined according to the year the request was made, the rates were seen to be 1,5% in 2011, 15.6% in 2018, and 22.6% in 2019, and it was observed that as the years increased, there was an increase in the request rates.

Reasons for CBCT request	N (%)
Implant treatment planning	3711 (45.18)
Embedded tooth	1223 (14.89)
Maxillofacial and dental lesions	1214 (14.78)
Orthodontic treatment planning	482 (5.87)
Maxillofacial or dental fracture	301 (3.66)
Cleft lip or palate	227 (2.76)
Follow-up of the development of dentition	217 (2.64)
TME pathologies	203 (2.47)
Maxillofacial tumour	146 (1.78)
Orthognathic surgery	106 (1.29)
Alveolar bone defects	104 (1.27)
Number and status of anomalies	86 (1.05)
Facial pain	55 (0.67)
Dental germ absence	44 (0.54)
Sinus pathologies	25 (0.3)
Fracture or embedded dental root	23 (0.28)
Dental syndromes	17 (0.21)
Endodontic treatment planning	12 (0.15)
Sialadenitis	11 (0.13)
Forensic cases	7 (0.09)
<b>Total</b>	<b>8214 (100)</b>

**Table 3.** The reasons for requesting CBCT imaging [n (%)].

Years	N (%)
2011	121 (1.5)
2012	608 (7.4)
2013	702 (8.5)
2014	925 (11.3)
2015	553 (6.7)
2016	764 (9.3)
2017	882 (10.7)
2018	1278 (15.6)
2019	1859 (22.6)
2020	522 (6.4)
<b>Total</b>	<b>8214 (100)</b>

**Table 4.** Distribution of the CBCT images requested according to year [n (%)] (p<.05).

## Discussion

The use of CBCT has increased in dentistry practice in direct proportion to the number of radiological cases seen by dentists.<sup>12</sup> Accordingly, the data obtained in the current study showed an increasing number of CBCT requests over time. Arnheiter et al.<sup>13</sup> examined the CBCT requests for 329 patients. It was reported that the patients comprised 62% males and 38% females with a mean age of median of 50 years. The CBCT requests were mostly from the Department of Oral, Dental and Maxillofacial Surgery for dental implant planning. In the current study, the CBCT requests were examined in 8214 patients, comprising 52.85% females and 47.15% males with a mean age of 36 years. The mean age of the patients in this study was lower,

with one patient aged four years, for whom the CBCT request was made because of trauma.

A greater preference for CBCT technology by Surgery Clinics has been previously reported as it is used in evaluating oral and maxillofacial diseases.<sup>14</sup> CBCT has become widely used for preoperative evaluation and implant procedures to examine anatomic structures, especially the mandibular canal, and tissues, such as the maxillary sinus layer and mental foramen, to measure the vertical dimension of the jawbone and bucco-lingual thickness and to evaluate bone mineralisation.<sup>15</sup> In recent years, many studies used CBCT to evaluate the thickness and density of the jawbone in dentistry, especially in implant applications.<sup>15, 16, 17</sup> This was confirmed by the finding in this study that CBCT requests were made at the highest rate of 45.6% for implant treatment planning. In addition, requests were made in the surgery clinic for maxillofacial and dental lesions, fractures, tumors, facial pain, TMJ pathologies, sinus pathologies, sialadenitis, and alveolar bone defects.

CBCT has been reported to be used in orthodontics in evaluating the embedded teeth and intra-oral anomalies, airway analysis, and the height, volume and development of alveolar bone.<sup>19</sup> Although it was reported in a study with orthodontists that there was no significant difference in linear and angle measurement accuracy between 2D digital conventional and CBCT,<sup>20</sup> there are studies suggesting that 3D radiography gives clear images, especially in impacted canines, and is the most accurate tool to guide fixed orthodontic treatment in difficult patients, such as high-angle malocclusion.<sup>21, 22</sup> In the current study, CBCT was seen to be preferred mainly for the embedded tooth, orthodontic treatment planning, cleft lip and palate and orthognathic surgery. The reason for the high rate of CBCT requests in the Orthodontics Clinic is that guidance points and angles in the skull can be more accurately determined. The findings suggest that use in the Orthodontics Clinic will increase due to the development of computer programs, such as Dolphin and Mimics, which are used together with CBCT data to facilitate current orthodontic treatment.

Lui et al. suggested that CBCT provides accurate information in evaluating the positions of supernumerary teeth, their local effects and

their proximity to anatomical structures and that it should be used routinely.<sup>23</sup> In the current study, the reasons for CBCT requests from the Paediatric Dentistry Clinic were the status and number of anomalies, trauma, dental syndromes, follow-up dentition and dental germ absence.

Radiographic examination is a critical component of diagnosis and treatment in endodontics. CBCT imaging has been reported to have many potential application areas in the treatment of endodontic problems, such as root fractures, root canal anatomy, alveolar bone structure, the measurement of bone thickness before periapical surgery and the curve of roots compared to the jaw.<sup>24</sup> Kongkiatkool et al.<sup>25</sup> found that CBCT was more successful than digital periapical radiography in cases where the mandibular first premolar had two canals. In the current study, there were few CBCT requests from the Endodontics Clinic for treatment planning. This finding suggested that traditional methods were sufficient in the diagnosis and treatment planning of endodontic treatment and periapical lesions and were appropriate to be kept at the forefront for patients conforming to the ALARA principles.

Uthman et al. stated that sphenoidal sinus measurements in CBCT images might be useful in forensic identification.<sup>26</sup> In our study, the findings showed that 0.09% of the CBCT request was made in forensic identification.

FOV is a parameter showing the width of the image obtained on a tomography slice. While a wide FOV range is used for orthodontic purposes, covering a large area in implant treatment planning and orthognathic surgery planning and small FOV areas, have been reported to be effective in examining images, including fewer teeth and in the examination of localized areas, such as the examination of TME hard tissue.<sup>11</sup> Furthermore, the ideal FOV width is limited to the relevant area only. Thus, the patient is only exposed to radiation of the involved tissue.<sup>27</sup> It is not appropriate to scan the whole maxillofacial region to obtain CBCT images of both jaws for treatment planning. In the current study, the CBCT images were obtained from both jaws in the same FOV.

As a limitation of this study, the reason for the decrease in the reasons for the CBCT demand in 2020 is the COVID-19 pandemic that started in March.

## Conclusions

CBCT examination was requested by the Oral and Maxillofacial Surgery Clinic with a rate of 48.6% for dental implant treatment planning. Determining the reasons for requesting CBCT and the increase of requests over the years suggested that new screening protocols are required to use CBCT in dentistry.

## Declaration of Interest

The authors report no conflict of interest.

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