

## Reasons for Use of Cone Beam Computed Tomography in Pediatric Dentistry

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### Abstract

The aim of the study is to determine the reasons for the request for Cone Beam Computed Tomography (CBCT) in pediatric dentistry and to evaluate the relationship between common indications and the field of view (FOV).

CBCT request forms, which were created for the follow-up of patients aged 5-16 years, who underwent advanced imaging methods in our clinic for various reasons, were retrospectively evaluated. CBCT request reasons were classified as follows; impacted teeth, TMJ, pathology, dental anomaly, CLP and trauma. The FOV size was grouped as 40×40 mm, 60×60 mm, 100×100 mm and 140×100 mm. The obtained data were analyzed using descriptive statistical methods.

In this study, CBCT records of 237 patients aged 5-16 were analyzed. Imaging due to impacted teeth evaluation (27.85%) is in the first place. This is followed by dental anomalies (24.47%) and trauma (17.72%), respectively. In addition, it was determined that 108 (46%) patients were imaged with a 40×40 mm FOV and 58 (24%) patients were imaged with a 60×60 mm FOV.

Our study shows that CBCT is most commonly used for the evaluation of impacted teeth, followed by the detection of dental anomalies and post-traumatic evaluation. In addition, small FOV is often used in imaging.

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### Introduction

It is very difficult to diagnose and plan treatment based on clinical examination alone in dentistry. Therefore, clinical and radiographic examination are required to be considered and evaluated as a whole. In the past, two-dimensional radiographic examination methods have been used as an auxiliary method for the clinical examination and considered sufficient in the routine practices. However, with the development of technology, three-dimensional imaging methods applied in medicine and dentistry have been developed to facilitate diagnosis.<sup>1</sup>

It is a known fact that x-rays used to create images in radiographs have harmful effects on tissues. Such effects can be persistent on the genetic material and be transferred to the

next generations accordingly. Associated with the rate of mitosis, the highest damage occurs in the pediatric population, while the least damage occurs in the adults.<sup>2,3</sup> Therefore, it should be noted that the infants, children and adolescents constituting the pediatric population are more vulnerable to the radiation comparing to the adults. For this reason, a detailed clinical examination is required to be performed prior to the radiological examination and it should be sensitively decided which radiographic method the patient requires. Three basic principles of radiation protection (justification, optimization and limitation) are always required to be taken into consideration while performing the radiographic examination. The imaging method should be chosen according to the needs of the patients, and the ALARA (As Low As Reasonably Achievable) principle, which allows obtaining the highest quality image possible with minimum radiation, is always required to be considered.<sup>3,4</sup>

Periapical, panoramic, occlusal and cephalometric radiographs are the imaging methods frequently applied in dentistry. These methods, widely applied today and considered sufficient in the routine practice, allow two-

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dimensional imaging of teeth, jawbone, anatomical formations and various pathologies.<sup>5</sup> However, in the event such as superposition, magnification and distortion, these methods remain insufficient and advanced imaging methods providing three-dimensional imaging are to be required accordingly.<sup>6</sup>

Magnetic resonance imaging (MRI), ultrasound, computed tomography (CT), cone beam computed tomography (CBCT) are the three-dimensional imaging methods.<sup>7</sup> Cone beam computed tomography is a relatively new radiological technique used in oral and maxillofacial radiology and provides a high diagnostic quality.<sup>8,9</sup> It was first developed in 1982 for the purpose of being used in angiography than it was started to be used in the maxillofacial imaging.<sup>10,11</sup> CBCT is commonly used in dentistry for various purposes such as three-dimensional examination of teeth, implant planning, pathologies, orthodontic purposes, impacted teeth localization, temporomandibular joint (TMJ) morphology, airway analysis, trauma, root canal morphologies, dental anomalies, supernumerary teeth, impacted teeth, orthognathic surgery, salivary and gland evaluations and examination of the maxillary sinus.<sup>12,13,14</sup> On the other hand, it is considered to be insufficient for differentiation of the soft tissue and preferred for the review of objects with high contrast such as teeth and bones.<sup>15</sup>

The advantages of CBCT are having a decreased radiation dose comparing to CT, less screening time, minimum metal artifacts and less requirement of complex equipment. The biggest advantage which comparison to the conventional radiographies is the ability to provide more detailed and real-like data. The disadvantages of CBCT are that it requires high doses and high-costs compared to conventional imaging methods.

There are different fields of view (FOV) in CBCT, which differ according to the device and are divided into large, medium and small sizes. FOV is the parameter indicating the size of the field of view comprising the tomography cross-section.<sup>16,17</sup> The limited imaging field in the CBCT is seen as a disadvantage, but it enables the limitation of the radiation dose. Many studies reported that the radiation dose given to the brain and thyroid is quite high when the FOV is large.<sup>17</sup> For this reason, attention is required to be paid to the use of CBCT, which has a higher radiation

dose than periapical and panoramic radiographs, especially in children and adolescents. In addition, dose adjustment and appropriate FOV size should be determined to reduce radiation exposure. Before the use of CBCT, benefit-harm ratio should be done, and in the existence of an appropriate indication, its use should not be inconvenient.<sup>18</sup>

When the reasons for the use of CBCT were examined in the literature, very few studies including the pediatric patients were encountered, and it was observed that conclusive outcome could not be obtained with respect to the size of the field of view, use criteria and the grounds of request.<sup>4,19,20</sup> In consideration this information, the aims of our study planned are to identify the grounds of applying for CBCT in pediatric dentistry, evaluating the most frequent indications in the pediatric patients and determine the correlation between the indications and the size of the imaging field.

## Materials and methods

Approval of the Ethics Committee of Non-Pharmaceuticals and Non-Medical Device Research of the Faculty of Dentistry of Necmettin Erbakan University has been obtained (2021/03-42). Our study included CBCT records of 237 patients aged 5-16 years, who applied to our clinic between 2018 and 2021 and requested cone beam computed tomography for various reasons. A retrospective evaluation of the pediatric dentistry archive records consisting of the files and CBCT request forms of the patients who were referred to advanced imaging methods was performed. Incompletely filled request forms and/or records that resulted in insufficient data were excluded from the study.

The grounds of CBCT request in the records were classified within the scope of our study as impacted teeth, dental anomalies (supernumerary teeth, dens in dente, mesiodens, dilaceration etc.), TMJ, pathology, cleft lip and palate (CLP) and trauma. The grounds of request for CBCT grouped under 6 headings were coded between 1 and 6. Moreover, demographic data and CBCT imaging field in the records has been evaluated. The FOV were grouped as 40×40 mm, 60×60 mm, 100×100 mm and 140×100 mm. For the patients with more than one grounds of request, the classification was made based on the indication that needed a larger FOV. The

data obtained were analyzed using descriptive statistical methods.

### Results

The CBCT records of 237 patients aged 5-16 (mean 10.02 ±2.83) were examined. Of the patients, 136 (57.38%) were female and 101 (42.62%) were male. The mean age of the female patients were 9.99 ±2.81, and the mean age of the male patients were 10.07 ±2.94 (Table 1).

	MEAN (MEAN±SD), years	
<b>AGE</b>	10.02 ±2.83	
Female	9.99 ±2.81	
Male	10.07±2.94	
	Number (n)	Percent (%)
<b>GENDER</b>	237	
Female	136	57.38%
Male	101	42.62%

**Table 1:** Demographic data of the patients.

Considering the grounds of request for CBCT, it was observed that the imaging performed due to impacted tooth evaluation (27.85%) was in the first place. This is followed by dental anomalies (24.47%), trauma (17.72%), pathologies (15.61%), temporomandibular joint evaluation (8.44%) and cleft lip and palate (5.91%) (Table 2).

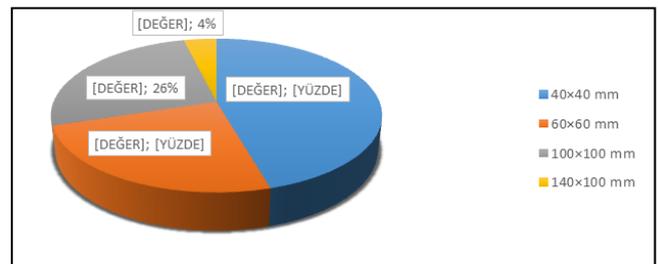
	Number (n)	Percent (%)
Impacted Teeth	66	27.85%
Dental Anomaly	58	24.47%
Trauma	42	17.72%
Pathology	37	15.61%
Temporomandibular Joint	20	8.44%
Cleft Lip and Palate	14	5.91%
<b>TOTAL</b>	<b>237</b>	

**Table 2.** Distribution of CBCT by grounds of request.

When CBCTs were evaluated according to the size of the field of view, it was concluded that the imaging of 108 (46%) of the patients were performed with 40×40 mm FOV, 58 (24%) patients were performed with 60×60 mm FOV, 62 (26%) patients were performed with 100×100 mm FOV and 9 (4%) patients were performed with 140×100 mm FOV. (Graphic 1).

When the correlation between the grounds for requests and the field of view, it has been observed that the most was performed with 40×40 mm FOV for the dental anomaly (47.22%), followed by 60×60 mm FOV for the impacted

teeth (36.21%), 100×100 mm FOV for the trauma examination (41.94%). 140×100 mm FOV was used only when temporomandibular joint evaluation was required. Furthermore, 63.64% of the CBCTs requested for the evaluation of the impacted teeth and 87.93% of the CBCTs requested for the purpose of examination of the dental anomalies were screened with 40×40 mm FOV. While 100×100 mm FOV imaging was applied for trauma by 61.90%, 60×60 mm FOV imaging was applied for pathologies 45.95%, 100×100 mm FOV imaging was applied for temporomandibular joint evaluation by 55.00% and 100×100 mm FOV imaging was applied for the patients with cleft lip and palate by 64.29% (Table 3).



**Graphic 1.** Distribution of CBCTs by the imaging field.

	Impacted Teeth		Dental anomaly		Trauma		Pathology		Temporomandibular Joint		Cleft Lip and Palate		TOTAL
	Number (n)	Percent (%)	Number (n)	Percent (%)	Number (n)	Percent (%)	Number (n)	Percent (%)	Number (n)	Percent (%)	Number (n)	Percent (%)	
40×40 mm	42	63.64%	51	87.93%	7	16.67%	8	21.62%	-	-	-	-	108
60×60 mm	21	31.82%	6	10.34%	9	21.43%	17	45.95%	-	-	5	35.71%	58
100×100 mm	3	4.55%	1	1.72%	26	61.90%	12	32.43%	11	55.00%	9	64.29%	62
140×100 mm	-	-	-	-	-	-	-	-	9	45.00%	-	-	9
<b>TOTAL</b>	<b>66</b>		<b>58</b>		<b>42</b>		<b>37</b>		<b>20</b>		<b>14</b>		<b>237</b>

**Table 3.** Distribution of FOVs based on CBCT requests.

### Discussion

CBCT has been applied in the dentistry for over 20 years. When the grounds for use of CBCT in dentistry were examined, it was often observed that adult patients were focused on. However, in a few articles, a sample group consisting of both adult and children were studied and the patients were evaluated according to the relevant departments.<sup>21-23</sup> These studies reported that CBCT is quite beneficial and convenient if used with the correct indication, and its ability to show detail is higher than intraoral radiographs and panoramic radiographs. It is seen that the application of CBCT in pediatric patients is still controversial when the literature on pediatric

dentistry is reviewed.<sup>4,24,25</sup> In these studies, it is emphasized that diagnostic benefits are required to be considered when making a decision to use of CBCT in pediatric population, and it is required to use the appropriate size imaging field and dose adjustment based on the age and weight of patients.<sup>26,27</sup>

In the study conducted by Hajem et al.<sup>19</sup> in pediatric patients under the age of 19 in Sweden, it was reported that 282 patients whose images were evaluated were females (45.6%), and 335 were males (54.3%), and the mean age was 12.5. In the study conducted by Yalçın and Artaş<sup>27</sup>, the grounds of request for CBCT, departments of filing the request and the size of the field of view have been evaluated and the mean age of the requests filed in the pedodontics department was reported as 11. Van Acker et al.,<sup>28</sup> 135 patients contacted to use their images in the study and 79 patients agreed to be included. It was stated that the mean age of the included patients, 35 were females and 44 were males, was 12.35±2.75. In this study, our sample consisted of CBCT records of 237 patients, of which 136 (57.38%) were females and 101 (42.62%) were males, and the mean age of these patients was 10.02±2.83.

In the study conducted by Van Acker et al.<sup>28</sup> in pediatric dentistry, the grounds for referral of patients under the age of 18 who underwent CBCT scanning were examined, and whether there was a correlation between the age, gender, FOV, and resolution. As a result of the study, 59 (81%) of the CBCTs have been imaged with a 50x55 mm FOV. The 6-year retrospective evaluation of CBCTs imaged with orthodontic purposes was made by Dobbyn et al.,<sup>25</sup> 290 CBCTs were examined within the scope of the study and it was concluded that small FOVs (with the height of maximum 5 cm) constitute 50.5% of the sample. Hidalgo-Rivas et al.<sup>22</sup> also reported that 81.5% of the CBCTs were imaged with small FOV. In our study, it has been revealed that imaging of 108 (46%) patients were performed with 40x40 mm FOV, 58 (24%) patients were performed with 60x60 mm FOV, 62 (26%) patients were performed with 100x100 mm FOV, and 9 (4%) were performed with 140x100 mm FOV. Screening was performed with 166 (70.04%) patients by smaller (40x40 mm and 60x60 mm) FOV. The reason for this was the need to minimize the exposure to radiation dose and the majority of the grounds of request for

CBCT was cases where a smaller field of view was required such as impacted teeth, dental anomalies and dental trauma.

De Vos et al.<sup>21</sup> compiled a list of study results evaluating the use of CBCT. According to the results, the use of CBCT was mostly occurred in maxillofacial surgery (41%), followed by detection of dentoalveolar issues (29%), orthodontics (16%) and dental implantation (11%). In the study conducted by Amuk and Yılmaz<sup>29</sup>, the grounds of the requests for CBCT, the requesting department and the grounds for filing the request, and their distribution by gender were examined accordingly. It was reported that CBCT imaging was requested mostly from the department of oral and maxillofacial surgery (42.56%), and the department of pediatric dentistry (0.63%) was revealed to be in the lower ranks. In this study, it was observed that the first reason for CBCT imaging was 'implant evaluation' (33.38%). This was followed by impacted teeth (32.33%) and lesions (12.92%). Further, it was concluded that the indications for the use of CBCT in pediatric dentistry have not been sufficiently focused on yet and that more studies are needed.

In another study conducted by Hidalgo-Rivas et al.<sup>22</sup> in which the images of pediatric and adult patients were included, the grounds of request for CBCT were classified according to the departments that made the request, the most frequent requests filed by which department and the most common purposes of CBCT imaging was examined accordingly. The results of the study have reported that the patients who were requested from the pediatric dentistry comprised 13.7% of the study group. CBCT was used most frequently in the department of pediatric dentistry with the aim of 'evaluation of the impacted canine and detection of resorption in adjacent teeth' (38%). TMJ, Cleft palate, and dental trauma evaluation are at the end of the list. In the study conducted by Temur et al.,<sup>20</sup> 210 pedodontists were surveyed on electronic environment and in which situations physicians needed CBCT in pediatric patients was evaluated. The results of the study reported that the pedodontists resort to the use of CBCT more in the cases of cyst/tumor. Ertaş and Kalabalık<sup>23</sup> retrospectively evaluated the grounds of request for CBCT and the distribution of these requests by the age, gender and departments. In the examination conducted in the individuals under the age of 18, it was

concluded that CBCT was mostly applied for the evaluation of impacted canine teeth. This is followed by lesion (19%), eruption direction evaluation (15%), root canal configuration (12%), dental anomaly (8%), root resorption (4%), and trauma (4%). Our study reported that the most frequent ground of request for CBCT was "impacted teeth evaluation" in accordance with the literature. This is followed by dental anomalies (24.47%), trauma (17.72%), pathologies (15.61%), TMJ (8.44%) and Cleft Lip and Palate (5.91%). In our study, the rate of use of CBCT in the detection of dental anomalies was found to be higher than the literature. It was thought that the reason for this may be that the title of dental anomalies was kept wider than the literature (supernumerary teeth, dens in dente, mesiodens, dilaceration, etc.) and many CBCTs taken for endodontic purposes (such as the diagnosis of dens in dente root-canal malformation) were included in this group. The reason for the more widespread use of CBCT in trauma examination is that our centrally located faculty is accessible to many patients, including the surrounding provinces, and that trauma referrals of these patients who need advanced imaging are made to our hospital. Contrary to the literature, the use of CBCT was less preferred in our study for the purpose of examining pathologies. The reason for this is that suspicious lesions such as cysts/tumors are followed in the oral and maxillofacial surgery department of our faculty and CBCT requests are made from the relevant department, so they are not included in the pedodontics archive records. In our study, TMJ evaluation and CLP were among the last reasons for applying to CBCT, similar to the literature.

## Conclusions

In present study, it was concluded that the pediatric patients between the ages 5-16, CBCT was most commonly applied for the evaluation of impacted teeth, followed by the determination of dental anomalies and post-traumatic evaluation, and small FOV is most frequently applied during the imaging. In cases where three-dimensional imaging is expected to provide a therapeutic benefit in children or adolescents, benefit-harm ratio is required to be considered by specialist physicians having actual knowledge and skills grounds of request, indications and limitations of

CBCT, and the decision to resort to CBCT is required to be made by paying attention to the three basic principles of protection against the radiation.

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## Declaration of Interest

The authors report no conflict of interest.

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