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Assessment of cone beam computed tomography use in pediatric and adolescent patients: a cross-sectional study

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Abstract

Background The use of cone beam computed tomography (CBCT) for dentomaxillofacial diagnostics in pediatric dentistry is expanding and concerns have been raised about the radiation risks associated with this imaging modality, especially for children. Dentomaxillofacial paediatric imaging: an investigation towards low-dose radiation induced risks (DIMITRA) is a multidisciplinary project focused on optimizing CBCT exposure for children and adolescents. This study aims to clarify the indications behind CBCT scans in children aligned with DIMITRA's recommendations.

Methods For each CBCT examination, data were collected on patient age at the time of the CBCT examination, gender, reason for request, referring department, CBCT-requested region, and the field of view (FOV) dimension of imaging. The CBCT indications were categorized under six headings according to an adaptation of the DIMITRA project recommendations: impacted teeth, dentoalveolar trauma, orofacial clefts, dental anomalies, bone pathology, syndromes. Indications not categorized in DIMITRA were recorded below the heading "other".

Results The most common indication was the "other" category (34.8%), which included implant, temporomandibular joint dysfunction, orofacial anomalies, foreign object and root canal morphology. The least common indication was "orofacial cleft" (1.9%) and no requests were made for cases related to syndromes. Detection of supernumerary tooth in dental anomalies (68.6%) was the most common CBCT indication, while dentigerous cysts (37.6%) were among the most common CBCT indication in bone pathologies and orofacial anomalies (68.1%) in the other category. The most common size was External Center (15 × 15 cm) (27%) and the least common size was Both Arches/small (8 × 8 cm) (0.4%) when the CBCT FOV was analysed.

Conclusions Although the option of a smaller FOV size was available, the larger FOV size that included the both jaws were most frequently used. When justifying CBCT requests, patient-specific radiation dose risks should be considered and specific guidelines should be followed.

Keywords Cone beam computed tomography, Oral pathology, Orthognathic surgery, Pediatric dentistry

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Background

Dental radiographs are defined as valuable adjuncts in supporting clinical examination for diagnosing oral diseases, monitoring maxillofacial development, and planning treatments [1]. In pediatric patients, radiographs are especially used for assessing dentoalveolar trauma, detecting dental caries, identifying tooth development disorders, and examining pathological conditions [2]. Periapical and panoramic radiographs are commonly used in dentistry for this purpose. However, the overlapping and distortion of structures in plain radiography may lead to diagnostic uncertainty in some cases. In contemporary dentistry, cone beam computed tomography (CBCT) allows for obtaining high-quality three-dimensional (3D) images. CBCT offers a comprehensive view of the examined structure, providing cross-sectional perspectives and multi-plane reconstruction of the maxillofacial region, including tooth and craniofacial anatomy [3, 4]. CBCT, capable of providing precise measurements in calcified tissues, finds extensive application in implant surgery, orthodontic treatment, maxillofacial surgery, and evaluation of bone pathologies [5]. Moreover, the applicability of CBCT in dental specialties, including pediatric dentistry, is increasing in the examination of root canal morphology, identification of dental anomalies, evaluation of dentoalveolar trauma, determination of temporomandibular joint morphology and evaluation of pathologies [6]. However, the increased usage of CBCT in both pediatric and adult populations raises concerns due to the higher radiation dose compared to plain radiography [7]. Exposure to ionizing radiation carries the risk of causing various mutations in the body. Since tissue growth occurs faster in children, they are 2–10 times more sensitive to ionizing radiation than adults. In addition, the risk of stochastic effects of radiation is also higher in children [8, 9]. Therefore, it is very important to adjust the radiation dose according to the age and body weight of the child, minimize unnecessary repetitions and justify it according to diagnostic benefits [9]. The International Commission on Radiological Protection (ICRP) underscores caution in employing dental CBCT for pediatric patients due to their heightened radiosensitivity and smaller size [10]. Dentomaxillofacial paediatric imaging: an investigation towards low-dose radiation induced risks (DIMITRA) has developed patient-specific and indication-specific recommendations to judiciously employ CBCT in children. In addition, The approach encourages transitioning from As low as reasonably achievable (ALARA) and As low as diagnostically acceptable (ALADA) principles to As low as diagnostically acceptable being indication-oriented and patient-specific (ALADAIP) [11, 12]. In order to reduce radiation exposure, it is important to be able to decide when to request a CBCT scan in children and standardization is required [6]. Nevertheless, a comprehensive review of the literature reveals a paucity of studies detailing common reasons for CBCT requests in children and adolescent [6, 13–16].

Given the limited evidence regarding indications, this study aims to clarify the reasons behind CBCT scans in children aligned with DIMITRA's recommendations. Additionally, the study retrospectively examines the distribution of these indications across departments, oral regions, and field of view (FOV) dimension.

Methods

Ethical approval

The current study obtained approval from the Clinical Research Ethics Committee at the Medical School of Tokat Gaziosmanpaşa University (Approval No. 23-KAEK-090 and dated 10.04.2023). This study was conducted in strict adherence to the guidelines of the Helsinki Declaration.

Sample size calculation

The sample size was calculated using G Power software version 3.1.9.2. A minimum of 341 children was required to detect a significant difference using the "Goodness of fit test" test, with a type I error (α) of 0.05, power (1-beta) of 95%, and effect size of 0.310 [13]. The study was completed with a sample of 270 children, resulting in a achieved power (1-beta) of 87%.

Study design

This retrospective study includes the reasons for CBCT request at Tokat Gaziosmanpaşa University Faculty of Dentistry between January 2013 and January 2022. Before 2019, patients were referred to an external center for CBCT because the faculty did not have a CBCT device. The acquisition parameters of the images obtained from the external center were 98 kVp, 15–30 mA, 14 s. Current CBCT imaging was obtained using Kavo OP 3D Vision (Imaging Sciences International LLC, USA) with the following parameters: a current intensity of 5 mA, 8.9–17.8 s and 90 kVp. Voxel sizes of the images ranged from 200 to 400 μm. The FOV dimension of the CBCT scan was documented as Expanded 3D Ceph (23×17 cm), External Center (15×15 cm), 3D Ceph(16×13 cm), Arches/TMJ-large (16×11 cm), Arches/TMJ (16×10 cm), Both Arches (16×8 cm), Maxilla-Mandible (16×6 cm) and Both Arches small (8×8 cm).

The study included patients aged 6–19 years who underwent CBCT examinations. The informed consent was obtained verbally and in writing from the parents or legal guardians of all patients before CBCT scanning. Repeated CBCT scans on the same patients and those with inadequate visibility due to artifacts caused by patient motion or metallic objects were excluded from

Table 1 Distribution of age groups by gender

Age	Gender		Total (%)
	Female *n* (%)	Male *n* (%)	
6–12	34 (42.5)	46 (57.5)	80 (29.6)
13–19	118 (62.1)	72 (37.9)	190 (70.4)
Total (%)	152 (56.3)	118 (43.7)	270 (100)

the study. For each CBCT examination, data were collected on patient age at the time of the CBCT examination, gender, reason for request, referring department, CBCT-requested region, and the FOV dimension of imaging. The data were collected from the OnDemand3D database (CyberMed, Seoul, Republic of Korea) and the electronic patient database.

The CBCT indications were categorized under six headings according to an adaptation of the DIMITRA project recommendations: impacted teeth, dentoalveolar trauma, orofacial clefts, dental anomalies, bone pathology, syndromes [12]. Indications not categorized in DIMITRA were recorded below the heading "other". The other category encompassed indication related to implant, temporomandibular joint (TMJ) dysfunction, orofacial anomalies, foreign object and root canal morphology.

All data were reviewed by a calibrated a dentomaxillofacial radiologist with experience in CBCT, retrospectively (M.C.). The dentomaxillofacial radiologist evaluated the indications according to DIMITRA, their distribution by department, the FOV dimensions of the image. When that indication was unclear based on justifications, she evaluated the images and reached the final decision.The evaluation were conducted using a consistent medical monitor (T3620 27-inch monitor, 1920×1200-pixel resolution, and 64-bit color support, Dell, Round Rock, TX, USA) with a black background and subdued lighting.

Statistical analysis

Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS for Windows, version 26.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics including number and percentage for categorical data were calculated. Chi-square test was used to compare categorical data. The correlation between FOV dimension and age was investigated with Spearman rank correlation coefficient. A p-value of <0.05 was considered statistically significant in all tests.

Results

The total number of CBCT scans of 313 patients who had been referred for a CBCT scan comprised 15.3% of all patients (including adults). According to the inclusion/exclusion criteria, 270 (86.3%) of 313 CBCT scans were included in the study. Repeat images (for follow-up) from 40 patients (12–19 years), 2 images with intense motion artefacts (8 and 11 years) and 1 image with a placeholder (lingual arch) (10 years) were excluded from the study. The mean age of all patients who underwent CBCT scanning was 14.63±3.80 years. The mean age of patients between 6 and 12 years was 9.48±1.79, while the mean age of patients between 13 and 19 years was 16.79±1.95 (Table 1).

Table 2 Distribution of indications for a CBCT scan

Indications	*n* = 270	%
Impacted teeth (19)		7
Ankylosis	2	10.5
Resorption in the adjacent teeth	10	52.6
Position	6	31.6
Lack of space	1	5.3
Dentoalveolar trauma (16)		5.9
Crown-root fracture	5	31.2
Alveolar fracture	5	31.2
Jaw fracture	3	18.8
Avulsion	3	18.8
Orofacial cleft (5)		1.9
Cleft lip and palate	5	100.0
Dental anomalies (51)		18.9
Supernumerary tooth	35	68.6
Malpositioned tooth	7	13.7
Dilaceration of tooth	3	5.9
Dens in dente	3	5.9
Microdontia	2	3.9
Tooth agenesis	1	2.0
Bone pathology (85)		31.5
Radicular cyst	28	32.9
Residual cyst	1	1.2
Dentigerous cyst	32	37.6
Odontogenic keratocyst	6	7.1
Simple bone cyst	1	1.2
Odontoma	6	7.1
Central giant cell granuloma	9	10.6
Fibro-osseous lesion	2	2.4
Syndromes (0)	0	0.0
Other (94)		34.8
Implant	18	19.1
TMJ dysfunction	4	4.3
Orofacial anomaly	64	68.1
Foreign object	2	2.1
Root canal morphology	6	6.4

As shown in Table 2, there are a total of 29 indications under the headings of impacted teeth, dentoalveolar trauma, orofacial cleft, dental anomalies, bone pathology, syndromes and other. The most common reason for indication was the other category (34.8%), which included implant, TMJ dysfunction, orofacial anomalies, foreign object and root canal morphology. The least common reason for indication was "orofacial cleft" (1.9%). There was no indication for CBCT due to the syndrome. The most common indication for CBCT in impacted teeth

Table 3 Comparison between indications and referring department

Indications	Referring Department					*p*
	Orthodontics	Oral and Maxillofacial Surgery	Pediatric Dentistry	Oral and Maxillofacial Radiology	Endodontics	
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	
Impacted teeth	1 (16.7)	6 (3.6)	4 (6.8)	8 (23.5)	0 (0)	< 0.001
Dentoalveolar trauma	0 (0)	7 (4.2)	8 (13.6)	1 (2,9)	0 (0)	
Orofacial cleft	0 (0)	5 (3.0)	0 (0)	0 (0)	0 (0)	
Dental anomalies	3 (50.0)	12 (7.2)	32 (54.2)	4 (11.8)	0 (0)	
Bone pathology	2 (33.3)	51 (30.5)	14 (23.7)	18 (52.9)	0 (0)	
Syndromes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Other	0 (0)	86 (51.5)	1 (1.7)	3 (8.8)	4 (100)	
Total	6 (2.2)	167 (61.9)	59 (21.9)	34 (12.6)	4 (1.5)	

Table 4 Comparison between indications and oral regions

Indications	Region			*p*
	Maxilla *n* (%)	Mandible *n* (%)	Maxilla-Mandible *n* (%)	
Impacted teeth	16 (84.2)	3 (15.8)	0 (0)	0.013
Dentoalveolar trauma	12 (75)	4 (25)	0 (0)	0.116
Orofacial cleft	4 (80)	0 (0)	1 (20)	0.268
Dental anomalies	44 (86.3)	7 (13.7)	0 (0)	< 0.001
Bone pathology	35 (41.2)	50 (58.8)	0 (0)	< 0.001
Syndromes	0 (0)	0 (0)	0 (0)	-
Other	31 (33)	28 (29.8)	35 (37.2)	< 0.001
Total	142 (52.6)	92 (34.1)	36 (13.3)	270 (100)
p	< 0.001	< 0.001	< 0.001	

was resorption of adjacent teeth (52.6%), in dentoalveolar trauma, crown-root fractures (31.2%) and alveolar fractures (31.2%) were observed. The most common indications for CBCT were supernumerary tooth detection in dental anomalies (68.6%), dentigerous cyst (37.6%) in bone pathologies and orofacial anomalies (maxillary stenosis, maxillary retrognathia, maxillary prognathia, mandibular retrognathia and mandibular prognathia) (68.1%) in the other category (Table 2).

The Department of Oral and Maxillofacial Surgery made the most CBCT request (61.9%), while the Department of Endodontics made the least (1.5%). The referring departments and indications displayed statistically significant differences ($p<0{,}001$). Orofacial anomalies were the most prevalent indication for the Department of Oral and Maxillofacial Surgery in the other category (51.5%). Dental anomalies were the predominant indications for Orthodontics and Pediatric Dentistry (50.0% and 54.2%, respectively). Bone pathology was the primary indication for the Department of Oral and Maxillofacial Radiology (52.9%), while root canal morphology was the most common indication for the Department of Endodontics (100.0%) (Table 3).

In Table 4, it was observed that the most frequently examined region in all indications was the maxilla (52.6%). CBCTs requested for impacted teeth were predominantly acquired for the maxilla (84.2%), revealing a statistically significant difference when compared to other regions ($p=0.013$). A statistically significant relationship was noted between the specific oral region and CBCT requests for dental anomalies, with 86.3% of requests originating from the maxilla ($p<0.001$). There was a significant difference between bone pathology and the oral region in which CBCT was requested ($p<0.001$). For CBCTs referred for bone pathology, the greatest difference in the oral region is between the mandible and maxilla-mandible regions (58.8% vs. 0%, respectively). Lastly, a statistically significant difference was observed between CBCT requested for the related oral region and the other category ($p<0{,}001$). The difference was found to be between mandible and maxilla and between mandible and maxilla-mandible requests (29.8% vs. 33% and 29.8% vs. 37.2%, respectively).

Examining the CBCT FOV, the most common dimension was External Center (27%) while the least common dimension was Both Arches/small (0.4%). A statistically significant difference was found between requests and External Center FOV ($p=0.037$). The most common FOVs were External Center (47.7%, 40%, 28.6%, respectively) for the other category, orofacial cleft and bone pathologies, while Maxilla/Mandible FOV (44.4%, 42.0%, 37.9%, respectively) was prevalent for impacted teeth, dental anomalies, and bone pathologies. Significant differences were observed between departments regarding Maxilla/Mandible, 3D Ceph FOV and External Center images ($p<0.001$, $p=0.043$ $p<0.001$; Table 5). For Maxilla/Mandible FOV, this difference stemmed from the Department of Pediatric Dentistry (38.1%) and the Department of Oral and Maxillofacial Radiology (28.6%). the variance was primarily attributed to the Department of Oral and Maxillofacial Surgery (77.6%). For External Center FOV, the difference is related to the Department of Oral and Maxillofacial Surgery (93.1%). A positive

Table 5 Comparison between referring department and FOV dimension

	FOV Dimension								
Referrring Department	**Both arches small (8×8 cm)**	**Maxilla-mandible (16×6 cm)**	**Both arches (16×8 cm)**	**Arches/TMJ (16×10 cm)**	**Arches/ TMJ large (16×11 cm)**	**3D (16×13 cm)**	**External Center (15×15 cm)**	**Expanded 3D Ceph (23×17 cm)**	**Total**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Oral and Maxillofacial Surgery	0 (0)	16 (9.6)	9 (5.4)	6 (3.6)	19 (11.4)	38 (22.8)	68 (40.7)	11 (6.6)	167 (100)
Orthodontics	0 (0)	3 (50)	1 (16.7)	1 (16.7)	0 (0)	1 (16.7)	0 (0)	0 (0)	6 (100)
Pediatric Dentistry	1 (1.7)	24 (40.7)	8 (13.6)	8 (13.6)	11 (18.6)	3 (5.1)	3 (5.1)	1 (1.7)	59 (100)
Oral and Maxillofacial Radiology	0 (0)	18 (52.9)	3 (8.8)	2 (5.9)	3 (8.8)	7 (20.6)	1 (2.9)	0 (0)	34 (100)
Endodontics	0 (0)	2 (50)	1 (25)	0 (0)	0 (0)	0 (0)	1 (25)	0 (0)	4 (100)
Total	1 (0.4)	63 (23.3)	22 (8.1)	17 (6.3)	33 (12.2)	49 (18.1)	73 (27)	12 (4.4)	270 (100)
p	0.269	**<0.001**	0.93	0.39	0.582	**0.043**	**<0.001**	0.139	

correlation was found between FOV and age ($r=0.522$, $p<0.001$).

Discussion

With the widespread use of CBCT devices, the utilization of CBCT has increased across all dental specialties, including pediatric dentistry [17]. In parallel, evidence-based guidelines for justification, optimisation and referral criteria for CBCT have become necessary. Safety and Efficacy of a New and Emerging Dental X-ray Modality (SEDENTEXCT) and DIMITRA are guides developed for this purpose. The DIMITRA study was conducted to assess the health risks associated with low doses of radiation in pediatric dentistry and to provide recommendations for CBCT usage. The SEDENTEXCT guidelines do not provide specific guidelines for paediatric dentistry [18]. Justifying the indications for CBCT in pediatric patients is of paramount importance due to children's heightened sensitivity to radiation and the potential for long-term tumor development compared to adults [3]. Therefore, this study retrospectively analyzed the CBCT indications in patients aged 19 and younger based on DIMITRA recommendations.

A study of 649 CBCT requests of 649 patients aged 18 years and younger reported the most common clinical indications as malocclusion and dentofacial anomaly (28.7%), cyst and other bone pathologies (20.1%) and impacted tooth (16.9%) (Ismayılov and Özgür). In study of patients aged 17 years and younger using SEDENTEXCT guidelines, the CBCT indications were as follows: dentofacial anomalies (38.5%), impacted teeth (34.3%), pathology (17.9%), trauma (4.6%), cleft palate (2.4%) and TMJ issues (1.5%) [16]. In this study, the most common CBCT indications were categorized as other (34.8%), followed by bone pathology (31.5%), dental anomalies (18.9%), and impacted teeth (7%). The difference may be due to the wider age range in our study and the use of different guidelines. The percentages for trauma, cleft lip and palate, and TMJ issues were consistent with those reported in similar studies conducted in the Turkish population [13, 16]. Notably, TMJ-related indications ranked lower in this study, as MRI is the standard imaging method for TMJ dysfunction [19], making CBCT less preferable.

Similarly, in line with the literature, the Department of Oral and Maxillofacial Surgery accounted for the majority of CBCT requests (61.9%) [16, 20]. The Department of Oral and Maxillofacial Surgery is a branch where CBCT imaging is important for bone pathologies and orthognathic surgery planning. In contrast, Yiğit et al. [6]. and Ismayılov and Özgür [21] reported the Department of Oral and Maxillofacial Radiology as the department with the highest number of requests (respectively 53.6% and 51%). In this study, requests from the Department of Oral and Maxillofacial Radiology ranked third (12.6%). The difference between the studies may be due to the age of the patients examined in the Departments of Oral and Maxillofacial Radiology (Yiğit et al. [6]. >12 years, >14 years in this study). The department with the lowest number of requests was the Department of Endodontics (1.5%), consistent with the literature [4, 6, 16]. Endodontists may have requested CBCT scans to evaluate root canal morphology in detail, especially in cases where conventional periapical radiographs are insufficient [22, 23]. Therefore, CBCT imaging may be indicated for complex root canal anatomies, provided a limited FOV (<5 cm) is used [24].

A study analyzing CBCT requests by pedodontists identified the following indications: impacted teeth (23%), supernumerary teeth (21%), pathology (20%), root resorption (14%), pulpal anatomy (9%), and trauma (7%) [25] and the study was based on the SEDENTEXCT project. In this study, pedodontists' indications were primarily for supernumerary teeth (37.2%), pathology (23.7%),

trauma (13.6%), and impacted teeth (6.8%). The difference between supernumerary and impacted tooth rates may be due to the use of different guidelines in justification. Also impacted or supernumerary teeth may be asymptomatic and treatment may not be necessary [26]. Therefore, CBCT examination of impacted teeth is not always necessary [27].

Gümrü et al. [13] observed that the Department of Orthodontics commonly requested CBCT scans for cleft lip and palate cases, the Department of Pediatric Dentistry for impacted teeth, and the Departments of Oral and Maxillofacial Radiology, Oral and Maxillofacial Surgery, and Endodontics for pathology. In this study, the Departments of Orthodontics and Pediatric Dentistry made a higher number of CBCT indications for dental anomalies, while the Department of Oral and Maxillofacial Surgery focused on the other category (orofacial anomalies), and the Department of Oral and Maxillofacial Radiology primarily dealt with bone pathology. Supernumerary teeth can lead to displacement or delayed eruption of permanent teeth [28]. Management of supernumerary teeth is advised to be performed in the departments of orthodontics and pediatric dentistry [29]. Also, the Department of Oral and Maxillofacial Radiology performs the initial examination of patients over the age of 14 in our Faculty. CBCT is used for diagnostic purposes in patients with bone pathology such as cysts. These are possible reasons for the distribution of indications by department. In this study, most bone pathologies were radicular and dentigerous cysts. CBCT is instrumental in assessing the size, location, proximity to anatomical structures, and internal structure of pathological lesions [30], allowing for a more accurate referral diagnosis. Notably, the Departments of Periodontology, Prosthetic Dentistry, and Restorative Dentistry did not request CBCT scans in this study, consistent with existing literature [6, 13].

Studies have reported that CBCT requests for pediatric patients predominantly involve the maxilla [6, 19, 21]. In this study, the most frequently requested region was the maxilla. The maxilla is the most common location for supernumerary teeth [31]. The maxillary permanent canine is the most commonly impacted tooth after the third molar (Grover and Lorton). CBCT is used to determine complications and treatment of impacted teeth [32]. Maxillary incisors are the teeth most affected by trauma [33]. CBCT imaging is very useful when superimpositions prevent diagnosis in trauma cases [12]. Frequent requests for the maxilla can be explained by the above reasons. Furthermore, the requests for bone pathologies were in the mandible, similar to Yigit et al [6].

Regarding the choice of FOV, a study evaluating CBCT indications in the Orthodontic Department found that the smallest FOV (4×16 cm) was the most commonly used, followed by the largest FOV (22×16 cm) [20]. Among the studies involving patients under 18 years of age, one reported that 80% of the images were acquired a small FOV (5×5.5 cm), with larger FOVs reserved for surgical cases [14], while the other reported that a large FOV (20×17) was used for malocclusion and dentofacial anomalies in 74.1% of cases [16]. According to Ismayılov and Özgür study [21], small FOV≤10 cm was most frequently used. They reported that a large FOV (23×17 cm), which accounted for 29.6% of CBCT requests, was preferred in cases of malocclusion and dentofacial anomalies. In this study, a large FOV (15×15 cm) was the most frequently used, followed by a relatively small FOV (16×6 cm). Cases related to orofacial clefts, orofacial anomalies, and trauma often requires a larger FOV covering the craniofacial complex [18]. This choice is justified by the need for comprehensive assessment in cases requiring bimaxillary orthognathic surgery or when detailed evaluation of structures like the condyle and coronoid process is essential due to superposition in trauma cases. Of the patients included in the study, 33.3% were 18–19 years old. A larger FOV may have been preferred in this age group for craniofacial examination of orofacial anomalies. Although the use of large FOVs to evaluate the craniofacial area in the pediatric age group is controversial, it is stated in the SEDENTEXCT guideline that the use of large FOVs is valuable in the presence of complex craniofacial deformity requiring surgical intervention in patients aged 16 and over [18]. With increasing patient age, the selected FOV size increased, most commonly observed in the Oral and Maxillofacial Surgery department indications. Additionally, the present study detected that FOV size varied depending on the clinical indication. In cases involving impacted teeth, dental anomalies, and bone pathologies, the FOV typically encompassed only the relevant jaw (maxilla/mandible). However, a larger FOV including the relevant jaw was preferred to the smallest FOV size including both arches. When the FOV size increases, the radiation dose received by the patient increases significantly (DIMITRA). The results of this study show that the ALADIP approach, involving changes such as the selection of FOVs according to the case, is not being adequately considered.

According to a pediatric phantom study, the effective dose for a large FOV (height>15 cm) is above 352.5 μSv and for a small FOV (height<10 cm) is below 223 μSv [34]. Larger FOV selections increase radiation exposure to the thyroid [35], which is one of the most sensitive tissues in the head and neck [36]. The brain is also exposed to primary and secondary beam [34]. Modifications to protect the thyroid also reduce exposure of other tissues [37]. The most impressive method for reducing dose is to use a small FOV [38]. DIMITRA project recommends using a small FOV of 8×8 cm and states that at this FOV

size, dose safety is ensured and small details are visible [39]. But, for some specific indications, larger FOV restrictions (e.g. 5×5 cm) can be used to achieve dose reduction and improve image quality [12].

Plain radiography may not always provide adequate information, especially in cases of curved fracture lines or root fractures, which can be better visualized with high-resolution CBCT imaging [12]. It's important to note that motion artifacts are more likely to occur in pediatric patients [40], significantly compromising the quality of both plain radiography and CBCT. Therefore, when plain radiography is diagnostically suboptimal due to motion artifacts, CBCT may not indicated for pediatric patients.

Limitations

The study limitation is that the sample size determined in the power analysis was not reached. Due to the variety of CBCT devices and acquisition parameters available, studies could not be compared for FOV and effective dose.

Conclusions

Summarily, the most common indication for CBCT scans in this study was in the other category, which included implant, TMJ dysfunction, orofacial anomalies, foreign body, and root canal morphology. In the other category, orofacial anomalies requiring orthognathic surgery were found to be the primary reason. The Department of Oral and Maxillofacial Surgery and the Department of Pediatric Dentistry were the most frequent requesters of CBCT scans within the studied age range. Although the option of a smaller FOV size was available, the larger FOV size that included the both jaws were most frequently used. When justifying CBCT requests, patient-specific radiation dose risks should be considered and specific guidelines should be followed.

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Author contributions
All authors contributed to the study concept and design. Material preparation, data collection and data analysis were performed by SÇ, MÇ, GK and CBN. The first draft of the article was written by CBN and all authors contributed to the evaluation of the article. The final version of the article has been read and approved by all authors.

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Data availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The ethical compliance of the study was approved by the Tokat Gaziosmanpaşa University Clinical Research Ethics Committee (Approval Number: 23-KAEK-090 and dated: 10.04.2023). The informed consent was obtained verbally and in writing from the parents or legal guardians of all participants included in the study. The study was conducted in accordance with the Helsinki Declaration of Ethics for Medical Research Involving Human Subjects.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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