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Araştırma/ Research Article

EVALUATION OF REFERRAL OF CONE-BEAM CT INVESTIGATIONS AT A DENTOMAXILLOFACIAL RADIOLOGY CLINIC OF UNIVERSITY HOSPITAL

BİR ÜNİVERSİTE HASTANESİ DENTOMAKSİLLOFASİYAL RADYOLOJİ KLİNİĞİNDE KIBT İSTEMLERİNİN DEĞERLENDİRİLMESİ

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ABSTRACT
Objective: Recent researches provided an overview for advantages, disadvantages and indications/contraindications of Cone-Beam Computed Tomography (CBCT) as well as some thoughts on the current educational status of CBCT in dental schools. Reviews of recent publications reveal that CBCT is an important tool in the diagnostic process, even it plays an integral role in treatment planning and outcome assessment at different departments like maxillofacial surgery, orthodontics, periodontology and endodontics.
The aim of present study is to find out the indications and the most frequently used ones by reviewing the indications of CBCT at Dentomaxillofacial Radiology (DMFR) clinic, which were referred by other clinics/departments of the hospital.
Materials and Method:1590 CBCT indications defined from 1503 patients and their reports retrieved from the archieves of the DMFR clinic. Besides; referral reports, and Field of View (FOV- region) were also noted.
Results: CBCT imaging has mostly focused on applications for dental implant planning, impacted tooth extraction, orthodontic purposes and temporomandibular joint imaging.
Conclusion:CBCT is a 3D diagnostic tool contributing additional information to the clinical situation if the appropriate indication is used with the right FOV selection. In addition, the recent spread of implant treatments has led to the use of CBCT for implant planning.
Key words: CBCT, Indication, FOV, Applications of CBCT

ÖZ
Amaç: Son araştırmalar, Konik Işınlı Bilgisayarlı Tomografi'nin (KIBT) avantajları, dezavantajları ve endikasyonları / kontrendikasyonları yanı sıra dişhekimliği okullarında verilen mevcut KIBT eğitimi ile ilgili geliştirilen fikirler hakkında genel bir bakış sağlamıştır. Son yayınların değerlendirmeleri KIBT'nin tanısal süreçte önemli bir araç olduğunu ortaya koymaktadır. Hatta maksillofasiyal cerrahi, ortodonti, periodontoloji ve endodonti gibi farklı bölümlerin tedavi planlama ve sonuç değerlendirmesinde ayrılmaz bir rol oynamaktadır.
Bu çalışmanın amacı, hastanenin diğer klinikleri / bölümleri tarafından yönlendirilen Dentomaksillofasiyal Radyoloji (DMFR) kliniğindeki KIBT endikasyonlarını gözden geçirerek KIBT endikasyonları ile bunlardan en sık kullanılanları ortaya çıkarmaktır.
Gereç ve Yöntem:1503 hastadan 1590 KIBT endikasyonu tanımlandı ve raporları DMFR kliniğinin arşivlerinden alındı, sevk raporları ve İnceleme Alanı (FOV bölgesi) da not edildi.
Bulgular:KIBT görüntüleme çoğunlukla implant planlaması, gömülü diş çekimi, ortodontik amaçlar ve temporomandibuler eklem görüntülemesi uygulamalarına odaklanmıştır.
Sonuç:KIBT, uygun FOV bölgesi seçiminde uygun endikasyon kullanıldığında klinik duruma ek bilgi sağlayan 3B tanılama aracıdır. Ek olarak implant tedavilerinin yaygınlaşması, implant planlaması için KIBT kullanımının da artmasına yol açmıştır.
Anahtar kelimeler: KIBT, Endikasyon, FOV, KIBT Uygulamaları

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INTRODUCTION

The conventional panoramic radiographic and/or full-mouth intraoral radiographic analysis has been used in dentistry as a routine standart of dental radiographic examination with some degree of distortion and magnification.[1,2] But, maxillofacial region includes complex 3D anatomy and conventional 2D imaging modalities may fail to provide optimal visualization. So; indications for 3D imaging has started to find its place in dentistry in the last several decades for better visualization of maxillofaical region.[3]

CBCT imaging provides 3D volumetric data construction of dental and associated maxillofacial structures with high isotropic spatial resolution and high dimensional accuracy.[4] Recent advances in CBCT technology have allowed its commercial production and practical application in up-to-date patient care and dental education environment.[5]

CBCT device needs a single rotation dose to scan maxillofacial region with lower radiation when compared with multi-slice CT imaging modality, because of its lower tube power.[6] On the other hand, its low tube power generates images with less contrast, so it is impossible to visualize soft tissues with CBCT imaging.[7] However, regions with air-bone contrast structures like complex maxillofacial hard tissues can be monitorized easily.[8] Besides, its low cost and easy-to-use design according to multi-slice CT increase the frequency of use in dental field.

The use of CBCT raises some questions such as; "Does CBCT offer additional value in the diagnosis process and treatment planning of clinical dentistry?" or, "Does 3D evaluation contribute to improved patient care and treatment outcomes?" Before answering these questions, it is important to understand the advantages, disadvantages, indications, risks and benefits for use of this 3D imaging modality.[9] While radiologists generally know these issues, it is important that clinicians know about the basic features of CBCT. Thus, The reason for the request of the dentists working in other dentistry fields is thought to be valuable in understanding the subject.

The aim of the present study is to find out the indications and the most frequently used ones by reviewing the indications of CBCT exams at a Dentomaxillofacial Radiology (DMFR) Clinic, which were referred by other clinics/departments of the hospital.

MATERIALS AND METHOD

CBCT request forms of 1590 CBCT indications defined from 1503 patients were analysed to find the department which most frequently requested 3D imaging, the most commonly used indications in claim, the most commonly used Field of View (FOV) size and region of interest, finally gender and average age of patients. There were repeated indications in the 87 of these patients. But, through these two repeated indications, CBCT examinations of these patients were identified as taken from the same region and requested from the same department. So, the number of statistically analyzed CBCT indications were higher than the number of patients and also number of CBCT requests. CBCT images were obtained by using Planmeca 3D Pro-face (Helsinki, Finland) 3D imaging device. Request forms were analysed under five headings; the specified CBCT indications, age-gender, the requesting department, FOV size and region.

The specified CBCT indications were classified into 20 groups as follows:

1- Post-operative control of dental implant surgery
2- Determination of relation between impacted third molar and mandibular canal
3- Dental implant planning
4- Evaluation of temporomandibular joint (TMJ)
5- Maxillofacial fractures
6- Assessment of odontogenic cysts and tumors
7- Surnumerary and/or impacted teeth (except third molars)
8- Cleft palate
9- Paranasal sinus
10- Evauation of anatomical structures
11- Orthognathic surgery planning
12- Salivary gland pathologies
13- Numbness, parethesia, control
14- Foreign body
15- Sinus lifting planning
16- Surgical complications
17- Periodontal bone loss
18- Orthodontic analysis
19- Root fracture
20- Root resorption, ankylosis, tooth anomalies

The requesting departments were classified into 8 groups as follows:

1- Dentomaxillofacial Surgery
2- Periodontology
3- Dentomaxillofacial Radiology
4- Orthodonthics

5- Pedodontics
6- Endodontics
7- Prosthetics
8- Restorative Dentistry

The CBCT device used in the present study has 10 different FOV sizes and grouped as follows:

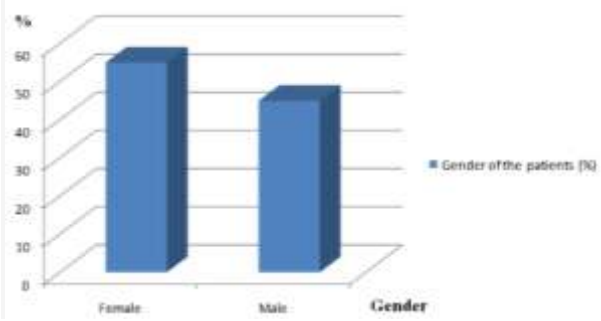
1- 50x55 mm
2- 100x90 mm
3- 100x55 mm
4- 130x90 mm
5- 130x55 mm
6- 230x160 mm
7- 230x260 mm
8- 130x160 mm
9- 130x130 mm
10- 50x55 mm (TMJ pair)

Additionally, the region of interest where CBCT images were taken from, was also noted for each CBCT image. All data collected from the request forms that retrieved from 4 years of archives (2014-2017) were statistically analysed by using frequency distribution tables.

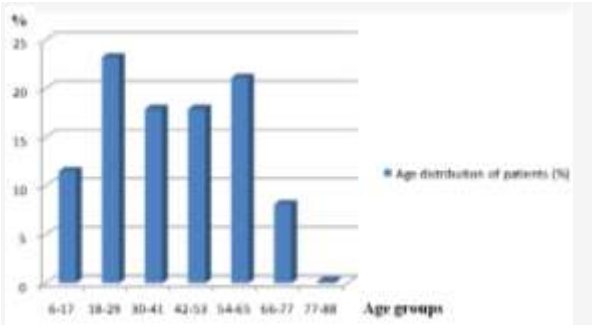
RESULTS

During 4 years period, 1503 patients were referred to DMFR clinic by other clinics/departments, and a total of 1590 CBCT indications were defined from them. 831 female (55%) and 672 (45%) male patients were referred to radiology clinic for CBCT examination (Graphic 1). Average age of female patients was 40 years, including, the youngest one was 6 years old and the oldest one was 84 years old. In addition, average age of male patients was also 40 years, including, the youngest one was 8 years old and the oldest one was 77 years old. 61 patients under the age of 18 (11,5%) underwent CBCT examination for several indications (Graphic 2).

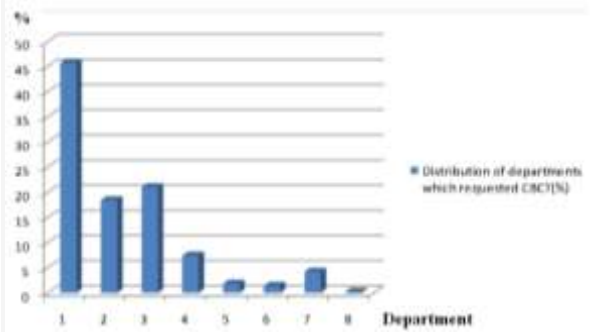
Graphic 3 shows the distribution of departments which requested CBCT by percentages. Rate of requests from dentomaxillofacial surgery department was the most with the percentage of 45,7%, while, the second department was dentomaxillofacial radiology with the percentage of 21% and the third department was periodontology with the percentage of 18,4%. The department which requested CBCT imagingthe least was found as restorative dentistry clinic with the percentage of 0,2%.



Graphic 1. Distribution of patients by gender

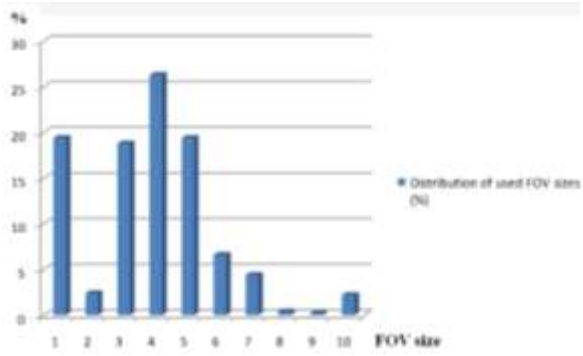


Graphic 2. Distribution of patients by age groups



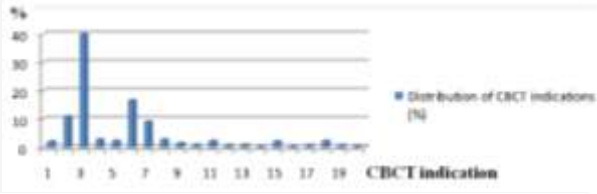
Graphic 3. Distribution of departments which requested CBCT imaging

Graphic 4 shows the most frequently used FOV sizes. The FOV size of 130x90 mm was found to be the most frequently used size (26,3%). The ensuing three places occupied by FOV sizes taken from only one jaw, as follows 50x55 mm (19,4%), 130x55 mm (19,4%) and 100x55 mm (18,8%) respectively. So that 54,3% of all received CBCT images were taken from one jaw while the proportion of CBCT images taken from both jaws were 37,5%.



Graphic 4. Distribution of used FOV sizes in CBCT examinations included in the study

Graphic 5 shows the distribution of CBCT indications. The most frequently used indication of CBCT request was dental implant planning with the percentage of 40%. The requests for indications of assessment of odontogenic cysts and tumors (16,6%), evaluation of relationship between impacted third molar (10,9%) and mandibular canal and surnumerary and/or impacted teeth except third molars (9,1%) were followed respectively. CBCT requests for foreign body and surgical complications were the least used indications with 0,2% and 0,4% respectively.



Graphic 5. Distribution of initial indications for CBCT requests

Table 1 shows the distribution of CBCT indications among age groups. Age group that applied the most was the 18-29 age group with the percentage of 23,2% approximately, followed by 54-65 age group with the percentage of 21,1% approximately. The 6-17 age group mostly applied for surnumerary and/or unerupted teeth except third molars (69 of 183 patients) and 18-29 age group mostly applied for evaluation of relationship between impacted third molar and mandibular canal (96 of 369 patients). The most frequently used indication of CBCT imaging was dental implant planning for all other age groups over age of 30.

DISCUSSION

CBCT examinations start to replace 2D imaging in recent years.[10,11] The main parameter that limits the use of CBCT especially in children is radiation dose, when it is compared with panoramic imaging. But, CBCT is still a good alternative to CT as an imaging technique of bony structures, because of lower irradiation in comparison with CT.[12,13] Also, guidelines recommend CBCT as an alternative 3D imaging tool to CT when necessary.[14] Present study showed that there were 183 patients under the age of 18 (11,5%) who were considered as child that underwent CBCT scan for the examination of bony structures in head and neck region. Besides, it was found that irradiation was most commonly performed for the indications of assessment of odontogenic cysts and tumors, surnumerary and/or impacted teeth (except third molars) and cleft palate indications in 6-17 age group. Frequency of CBCT use in children is

Table 1. Distribution of initial CBCT indications for requests among age groups

		Indications																				**Total:**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
Age Groups	**6-17**	0	6	3	0	6	54	**69**	33	0	0	0	0	0	0	0	0	0	6	3	3	**183 (11,5%)**
	18-29	9	**96**	66	12	18	42	39	9	12	6	27	0	3	0	0	3	0	18	6	3	**369 (23,2%)**
	30-41	3	48	**102**	12	6	60	15	3	3	6	3	6	3	0	6	0	3	3	0	3	**285 (17,9%)**
	42-53	9	18	**141**	6	6	54	9	0	3	0	3	3	6	0	15	0	3	6	3	0	**285 (17,9%)**
	54-65	6	3	**243**	12	0	24	6	0	6	3	3	3	3	0	12	3	6	3	0	0	**336 (21,1%)**
	66-77	3	3	**81**	3	0	30	6	0	0	0	0	0	0	3	0	0	0	0	0	0	**129 (8,1%)**
	77-88	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3(0,2%)**
Total:		**33**	**174**	**636**	**45**	**36**	**264**	**144**	**45**	**24**	**15**	**36**	**12**	**15**	**3**	**33**	**6**	**12**	**36**	**12**	**9**	**1590**

close to those of CBCT usage frequency in the other age ranges. Moreover, some of the most frequently used indications in this age group (assessment of odontogenic cysts and tumors and cleft palate) can probably require large FOV size. So, special radiation protections like adjusting the smallest possible FOV size to region of interest and reducing the current of device although allowing patient to wear lead aprons and thyroid protector for the prevention against harmful effects of irradiation should be performed especially for children.[15-17]

According to the results of the present study, the most common request of CBCT in dentistry area is dentomaxillofacial surgery (45,7%) with most requested indication of dental implant planning (40%). It is important to determine the surgical area three dimensionally with CBCT, which is essential for planning of dental implant or other surgical procedures.[18,19] The diagnostic ability of this 3D technology strengthen the clinician with the necessary tools to avoid potential complications and increases the clinician's confidence and predictability associated with implant dentistry.[20]

Generally, all CBCT units have several imaging protocols available that manufacturer's prescribed, so, those can be adjusted to most appropriate setup according to indication of imaging and anatomical characteristics of region of interest.[21] Based on ALADA principle ("As Low As Diagnostically Acceptable"), it is important to choose the appropriate protocol that provides the lowest dose to the patient while providing sufficient diagnostic information. Also, the radiation dose absorbed by the patient originated from selected FOV and exposure parameters.[22] Generally, CBCT devices have standardized exposure parameters due to patient size and it can be selected by operator in connection with patient's age and size. Furthermore, the CBCT device used in the present study had standardized 5 different patient size exposure parameters that could be adjusted automatically due to patient size. Thus, main tool to reduce the radiation dose was selection of FOV size. Because, it is a variable parameter selected by the operator according to its indication regardless of the size of the patient.

FOV sizes available in dental CBCT systems can be in a variety of dimensions which are suitable from a single dentoalveolar region (4×4 cm^2 or 5×5 cm^2) to full craniofacial imaging (from approximately 15×15 cm^2 up to 23×26 cm^2). The dimensions of the FOV vary according to the size and shape of the detector, the beam projection geometry and the device ability to collimate the beam.[23,24] According to the results of study, 54,3% of all received CBCT images were taken from one jaw while the proportion of CBCT images taken from both jaws were 37,5%. These results show that operators are paying attention to reduction of radiation dose by selecting a much smaller and possible FOV size more in the present study. Additionally, the use of 10 different FOV sizes in the present study within 2 years time shows that clinicians which requested CBCT take care to choose suitable FOV size for each indication.

Implant surgery has started to take place a large proportion in dentistry in recent years, which has led to a greater number of clinicians participating in surgical planning and participation in surgery. Although, both implant companies and imaging centers are encouraging the use of CBCT imaging to increase their chances of success and to have a word on the market. For these reasons, the most frequently used indication of CBCT request is dental implant planning.[10,11] The results of the present study also confirm the same in parallel with this situation with percentage of 40% over the age groups of 30, and the most requests were performed in 54-65 age group for dental implant planning on the side. According to findings, the other most preferred CBCT indications were determination of relation between impacted third molar and mandibular canal, assessment of odontogenic cysts and tumors and surnumerary and/or impacted teeth (except third molars) which were requested more than dental implant planning for age groups under age of.[30] The cause of age-related indication differences is seem to be pathologies that occur at different ages are also different. For example, while impacted third molar, surnumerary and/or impacted teeth (except third molars) or cleft lip palate pathologies are seen more frequently in children, dental implant surgery related with tooth deficiencies or dental prosthesis needover 30 years of age become more important.[25-29]

CONCLUSIONS

CBCT is a 3D diagnostic tool contributing additional information to the clinical situation if the appropriate indication is used with the right FOV selection. Thus, CBCT can be used most effectively and patients can be prevented from being exposed to unnecessary radiation.

Conflict of interest statements
The authors declare that they have no conflict of interest

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