



Reasons of Dental Volumetric Tomography Requests in a Faculty of Dentistry[#]

Gediz Geduk^{1,a}, Emre Haylaz^{1,b*}

¹Department of Dentomaxillofacial Radiology, School of Dentistry, Zonguldak Bulent Ecevit University, Zonguldak, Turkey

*Corresponding author

Research Article

Acknowledgment

#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 10/12/2021

Accepted: 12/01/2022

ABSTRACT

Objectives: Examining the reasons for the request of Dental Volumetric Tomography (DVT) by physicians may be beneficial in terms of improving the technique by determining the usage areas in dentistry faculties. The aim of this study is to examine the causes of DVT requests in patients who applied to the faculty of dentistry, and the distribution of these requests according to department, age and gender.

Material and Methods: In this study, Dental Volumetric Tomography (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)) request forms of 1571 patients between 2016-2019, taken at the Department of Oral, Dental and Maxillofacial Radiology of the Faculty of Dentistry of X University, were retrospectively analyzed. The age and gender of the patients included in the study, the reasons for requesting DVT and the departments requesting DVT were recorded. Chi-square test was applied on the obtained data to evaluate the relationship between descriptive statistics and reasons for desire age and gender. SPSS 22.0 Package Data Program (SPSS 22.0 Software Package Program, Inc. Chicago, IL, ABD) was used as statistical software in the study.

Results: Of the 1571 patients included in the study, 836 were female and 735 were male, and the mean age was 40.44±0.624 and 39.93±0.683 respectively. Considering the reasons for the DVT request of the patients included in the study, it is seen that the most requests were made for the evaluation of pre-operative implant planning (29.5%), the lesion (20.6%), and the third molar (11.6%) impacted in the mandible, respectively. In addition to these, a total of 26 different causes of DVT were identified, such as TMJ, sinus and trauma evaluations. When we look at the relationship between the reasons for the request and gender in the whole patient group, a significant difference was found compared to the chi-square test.

Conclusions: With the use of DVT in dentistry, its diagnosis and diagnosis capacity has started to develop rapidly. DVT, which enables three-dimensional imaging, enables the evaluation of anatomical structures in the head and neck region with its high resolution capacity. The use of Dental Volumetric Tomography in dentistry is increasing day by day due to its advantages such as giving clear images in terms of radiographically and examining the obtained sections from different angles.

Keywords: Dental Volumetric Tomography, Indication, Implant Planning, Lesion.

Bir Diş Hekimliği Fakültesindeki Dental Volumetrik Tomografi İstek Nedenleri[#]

Bilgi

#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen "Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi"nde sözlü bildiri olarak sunulmuştur.
*Sorumlu yazar

Süreç

Geliş: 10/12/2021

Kabul: 12/01/2022

Copyright



This work is licensed under Creative Commons Attribution 4.0 International License

ÖZ

Amaç: Diş hekimliği fakültelerinde Dental Volumetrik Tomografinin (DVT), hekimler tarafından istenme nedenlerinin incelenmesi, kullanım alanlarının belirlenerek, tekniğin geliştirilmesi açısından fayda sağlayabilir. Bu çalışmanın amacı, diş hekimliği fakültesine başvuran hastalardaki DVT istek nedenlerinin, bu isteklerin bölüm, yaş ve cinsiyete göre dağılımlarının incelenmesidir.

Gereç ve Yöntemler: Çalışmada, X Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Radyolojisi Anabilim Dalında çekilmiş, 2016-2019 yılları arasındaki 1571 hastaya ait Dental Volumetrik Tomografi (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)) istek formları retrospektif olarak incelendi. Çalışmaya dahil edilen hastaların yaşı, cinsiyeti, DVT istenme nedenleri ve DVT talep eden bölümler kaydedildi. Elde edilen veriler üzerinde tanımlayıcı istatistikler ve istek nedenleri ile yaş ve cinsiyet arasındaki ilişkiyi değerlendirmek için ki-kare testi uygulandı. Çalışmada istatistiksel yazılım olarak SPSS 22.0 Paket Veri Programı (SPSS 22.0 Software Package Program, Inc. Chicago, IL, ABD) kullanıldı.

Bulgular: Çalışmaya dahil edilen 1571 hastanın 836'sı kadın, 735'i erkek olarak belirlendi ve sırasıyla yaş ortalamaları 40,44±0,624 ve 39,93±0,683 olarak tespit edildi. Çalışmaya dahil edilen hastaların DVT istem nedenlerine bakıldığında ise sırasıyla en çok pre-operatif implant planlaması değerlendirilmesi(%29,5), lezyon(%20,6) ve mandibulada gömülü üçüncü molar(%11,6) dişleri değerlendirmek amacıyla istemler yapıldığı görülmektedir. Bunların yanı sıra TME, sinüs ve travma değerlendirmeleri gibi toplamda 26 farklı DVT istem nedeni tespit edildi. Tüm hasta grubunda istem nedenlerinin cinsiyet ile ilişkisine baktığımızda ki-kare testine göre anlamlı bir fark tespit edilmiştir

Sonuç: Günümüzde DVT'nin diş hekimliğinde kullanılmaya başlanması ile tanı ve teşhis kapasitesi hızla gelişmeye başlamıştır. Üç boyutlu görüntülemeye olanak sağlayan DVT yüksek çözünürlük kapasitesiyle baş boyun bölgesindeki anatomik yapıların değerlendirilmesine olanak sağlar. Dental Volumetrik Tomografinin radyografik açıdan net görüntü vermesi ve elde edilen kesitlerin farklı açıdan incelenebilmesi gibi avantajlarından dolayı diş hekimliğinde kullanımı giderek artmaktadır.

Anahtar Kelimeler: Dental Volumetrik Tomografi, Endikasyon, İmplant Planlama, Lezyon.

^a gedizgeduk@gmail.com

^b <https://orcid.org/0000-0002-9650-2149>

^c emrehylz03@gmail.com

^d <https://orcid.org/0000-0001-7330-9525>

How to Cite: Geduk G, Haylaz E.(2022) Reasons of Dental Volumetric Tomography Requests in a Faculty of Dentistry, Cumhuriyet Dental Journal, 25(Suppl): 13-18.

Introduction

Radiological imaging is an important diagnostic method in addition to the clinical evaluation of dental patients. With the use of panoramic radiography, the same natural limitations as in all two-dimensional projections began to appear with diagnostic losses in the increasing demands for radiographic imaging.¹ These diagnostic losses are magnification, superposition, inappropriate size changes, and misrepresentation of structures. Many advances have been made towards three-dimensional radiographic imaging (stereoscopy, computed tomography (CT)) and although CT is available, its use in dentistry has been limited due to its cost, accessibility, and dose values.²

The launching of dental volumetric tomography (DVT), which was developed specifically for imaging the maxillofacial region, provided a rapid transition from two-dimensional imaging to three-dimensional imaging and was a milestone in the field of dentistry.³ Interest in DVT in all areas of dentistry has revolutionized maxillofacial imaging, expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures.²

Unlike conventional tomography devices that are large, costly, and expensive to maintain, DVT is suitable for use in clinical dentistry applications because it is advantageous in terms of cost and dose.

DVT produces three-dimensional images that are useful for many oral and maxillofacial conditions and can guide the diagnosis and evaluation of diagnosis, treatment planning, application, and follow-up.⁴ Among the usage areas, implantology, surgery, endodontic applications, orthodontics and temporomandibular applications can be shown.⁵

Examination of the reasons why DVT is requested by physicians in dental faculties may be beneficial in terms of developing the technique by determining its usage areas. The aim of this study is to examine the causes of DVT requests in patients who applied to the faculty of dentistry, and the distribution of these requests according to department, age and gender.

Material and Methods

Prior to the study, the approval of the Non-Interventional Clinical Research Ethics Committee of our University (2021/21 decision no.) was obtained. In the study, DVT request forms of 1571 patients between the years 2016-2019, taken at the Department of Oral, Dental and Maxillofacial Radiology of the Faculty of Dentistry of X University, were analyzed retrospectively. (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)). The age, gender, reasons for requesting DVT, and

departments requesting DVT of the patients were recorded. The rates of requests for DVT by the departments, the most requested cases of DVT, and the mean age of patients who requested DVT were calculated.

Chi-square test was applied on the obtained data to evaluate the relationship between descriptive statistics and reasons for desire, age and gender. SPSS 22.0 Software Package Program (SPSS 22.0 Software Package Program, Inc. Chicago, IL, USA) was used as statistical software in the study.

Results

Of the 1571 patients included in the study, 836 were female and 735 were male, and the mean ages were 40.44 ± 0.624 and 39.93 ± 0.683 , respectively (Table 1).

When the reasons for DVT request of the patients are examined, the most requests are seen due to evaluation before implant planning (29.5%), evaluation of lesions (20.6%) and evaluation of impacted third molars in the mandible (11.6%). In addition to these, a total of 26 different causes of DVT were identified, such as Temporomandibular Joint (TMJ), sinus and trauma evaluations (Table 2).

When we observe the distribution of the three most requested examinations by regions, we detected that both jaws and the entire maxilla mandible are seen most frequently in the preoperative implant evaluation, while the distribution of the lesions is most frequently requested from the posterior region of the mandible (Table 3).

When we observe the relationship between the reasons for request and gender in the whole patient group, a significant difference was found compared to the chi-square test ($p < 0.05$) (Table 2). Among the reasons for the request, we detected a gender distribution in favor of women, especially in maxillary impacted wisdom teeth, sinus examinations, root resorption and root canal morphology evaluations.

The patient group included in the study was divided into three groups in terms of age 0-30, 31-60, 61-90 for ease of examination. When we examined the relationship between the causes of DVT requests and age, a statistically significant difference was found ($p < 0.05$) (Table 4).

When the distribution of the clinics that made the request was examined, it was determined that the Oral, Dental and Maxillofacial Surgery Clinic made the request with the highest number of 1171 patients among 1571 patients, followed by the Endodontics with 222 patients, Periodontology with 96 patients, Pediatric Dentistry with 48 patients and Orthodontics Clinic with 3 patients.

Table 1. Age-Gender Analysis

Gender	N	Mean	Std. Deviation	Minimum	Maximum
Female	836	40.44	0.624	4	89
Male	735	39.93	0.683	4	88
Total	1571	40.20	0.461	4	89

Table 2. Reasons for requesting DVT

DVT reasons	Number of People		Percent
	Female	Male	
Preoperative Implant Planning Evaluation	260	204	29.5%
Postoperative Implant Evaluation	2	2	0.3%
Evaluation of Impacted Mandibular Third Molars	96	87	11.6%
Evaluation of Impacted Maxillary Third Molars	33	17	3.2%
Evaluation of Mandibular Impacted Canines	15	15	1.9%
Evaluation of Maxillary Impacted Canines	63	48	7.1%
Evaluation of Lesions	165	159	20.6%
Temporomandibular Joint Evaluation	7	3	0.6%
Sinus Evaluation	8	15	1.5%
Evaluation of Other Impacted Teeth	42	41	5.3%
Trauma	9	20	1.8%
Evaluation of Supernumerary Teeth	20	29	3.1%
Evaluation of Mesiodens Teeth	14	26	2.5%
Radix	4	8	0.8%
Evaluation of Cleft Lip And Palate	2	1	0.2%
Paresthesia	2	3	0.3%
Oroantral Fistula	3	4	0.4%
Evaluation of Fracture Canal Instrument Location	3	5	0.5%
Evaluation of Soft Tissue Lesions	1	0	0.1%
Vertical Fracture Assessment	16	12	1.8%
Assessment of Root Resorption	18	7	1.6%
Root Canal Morphology Evaluation	46	24	4.5%
Presence of Foreign Body in The Sinus	0	1	0.1%
Dens Invajinatus	1	1	0.1%
Fusion	1	0	0.1%
Follow-Up Evaluation After Root Canal Treatment	5	3	0.5%
Total	1571		100.0%
	p=0.032		

Table 3. Frequency of DVT by requested regions

Request Reason	MAXA	MAXP	MAXAP	MANA	MANAP	MANAP	MM	Total
Preoperative Implant Planning Evaluation	28 (6%)	43 (9.3%)	89 (19.2%)	11 (2.4%)	74 (15.9%)	92 (19.8%)	127 (27.4%)	464
Evaluation of Impacted Mandibular Third Molars	0	0	0	0	183 (100%)	0	0	183
Evaluation of Lesions	77 (23.8%)	65 (20.1%)	17 (5.2%)	9 (2.8%)	140 (43.2%)	12 (3.7%)	3 (0.9%)	324

MAXA: Maxilla Anterior; MAXP: Maxilla Posterior; MAXAP: Maxilla Anterior Posterior; MANA: Mandible Anterior; MANAP: Mandible Posterior; MANAP: Mandible Anterior Posterior; MM: Maxilla Mandible

Discussion

In our study, the causes of DVT requests and the clinical divisions of these requests, their distribution according to age and gender were examined. Of the request forms included in the study, 836 were requested from female patients and 735 from male patients. The mean age of the female patients was 40.44 and the mean age of the male patients was 39.93.

Among the clinical departments, the Oral, Dental and Maxillofacial Surgery Clinic became the clinic with the highest number of requests with 1171 requests. Among the reasons for requesting DVT in the Oral, Dental and Maxillofacial Surgery Clinic; evaluation of third molars

and impacted teeth, examination of the placement of the mandibular canal, implant planning, evaluation of formations such as cysts and tumors, and inflammatory conditions in the jaws can be counted.⁶

Anatomical structures should be examined first in order to plan a successful implant. Knowing the anatomy of the mandibular canal, mental foramen and maxillary sinus, as well as examining the bone thickness and height in edentulous areas, is of great importance in determining the position of the implant to be placed in the mouth.⁷ The statistical data of our study showed that requests for the evaluation of preoperative implant

planning accounted for 29.5% of all DVT requests. Preoperative implant evaluation is at the top of all requests. In addition, DVT was requested from the Periodontology clinic in order to select the appropriate areas in the bone before the implant surgery, to make the correct measurements, to determine the number and size of the implants to be placed, and to evaluate the adjacent anatomical structures such as the maxillary sinuses and inferior alveolar nerve. In the study of Tarım *et al.*⁸, the reasons for the request for implant planning were reported as 25.19%, while Menziletoğlu *et al.*⁹'s study, this rate was reported as 43.12%. Especially in the maxillary posterior region, excessive trabeculation of the alveolar bone, the position of the maxillary sinuses, and sinus pneumatization after tooth extraction may result in failures in implant applications.¹⁰ In the mandible, complications may occur during implant applications in the mandibular posterior region as a result of the inferior alveolar nerve being close to the alveolar crest and the incomplete location of the mandibular canal.¹¹ For the evaluation of pre-operative implant planning, 9.3% of the DVT requests were requested from the posterior region of the maxilla and 15.9% from the posterior region of the mandible. In the evaluation of pre-operative implant planning, the least requested region was the anterior region of the mandible. In the anterior region of the mandible, the anterior extension of the mandibular canal

creates a formation called the 'anterior loop'. Concavities formed in the symphysis region are information that should be considered during implant applications.¹²

When evaluating pathological lesions, panoramic and periapical radiographs are insufficient to evaluate the lesion in three dimensions. In cases where two-dimensional imaging methods are insufficient, it is recommended to take DVT from patients in order to evaluate pathological lesions.¹³ With DVT, it is possible to evaluate cysts, tumors and similar lesions in the jaw bones in three dimensions. The dimensions of pathological lesions, their localization, their proximity to anatomical formations and the internal structure of the lesions can be evaluated.¹⁴ It was determined that the rate of DVT desired for imaging the lesions occurring in the jaws was 20.6%, and it took the second place among the reasons for request. In the study of Akarslan *et al.*¹⁵, DVT request evaluation for the evaluation of lesions took the second place in line with our study. In our study, 43.2% of the reasons for the request for the evaluation of lesions were requested from the posterior region of the mandible, and the most desired region was the posterior mandible for evaluation. The rate of DVT desired for the evaluation of lesions in the maxilla anterior region was in the second place with 23.8%. Menziletoğlu *et al.* found this rate as 51.83% for the posterior region of the mandible.

Table 4. Distribution of reasons for request by age groups

DVT reasons	Age Groups			Total
	0-30	31-60	61-90	
Preoperative Implant Planning Evaluation	118	259	87	464
Postoperative Implant Evaluation	1	3	0	4
Evaluation of Impacted Mandibular Third Molars	60	91	32	183
Evaluation of Impacted Maxillary Third Molars	17	24	9	50
Evaluation of Mandibular Impacted Canines	13	13	4	30
Evaluation of Maxillary Impacted Canines	40	52	19	111
Evaluation of Lesions	122	164	38	324
Temporomandibular Joint Evaluation	4	6	0	10
Sinus Evaluation	6	13	4	23
Evaluation of Other Impacted Teeth	38	36	9	83
Trauma	11	12	6	29
Evaluation of Supernumerary Teeth	30	17	2	49
Evaluation of Mesiodens Teeth	14	18	8	40
Radix	5	4	3	12
Evaluation of Cleft Lip And Palate	1	2	0	3
Paresthesia	2	2	1	5
Oroantral Fistula	2	3	2	7
Evaluation of Fracture Canal Instrument Location	5	2	1	8
Evaluation of Soft Tissue Lesions	0	1	0	1
Vertical Fracture Assessment	8	15	5	28
Assessment of Root Resorption	9	13	3	25
Root Canal Morphology Evaluation	20	40	10	70
Presence of Foreign Body in The Sinus	0	1	0	1
Dens Invajinatus	1	0	1	2
Fusion	0	0	1	1
Follow-Up Evaluation After Root Canal Treatment	5	2	1	8
Total	532	793	246	1571

p=0.022

The close relationship of the roots of the mandibular third molars with the mandibular canal poses a risk during

dentoalveolar surgery. Pinpointing the mandibular canal provides a safer approach to tooth extraction and root

elevation. Therefore, it is important to take DVT in addition to periapical and panoramic radiographs to evaluate the close relationship of the mandibular canal and mandibular third molars.¹⁶ In this study, the evaluation of the relationship between the impacted mandibular third molar teeth and the mandibular canal ranks third with 183 DVT requests, and the majority of these patients are in the 31-60 age group. In the literature review by De Vos *et al.*, they reported that the use of DVT in clinical practice is most commonly used in the examination of impacted teeth and implantology. In the study of Akarşlan *et al.*, DVT, which was requested to evaluate the relationship of impacted mandibular third molars with the mandibular canal, was ranked third. Except for the evaluation of the impacted mandibular third molars, a request was made for the evaluation of the most impacted maxillary teeth. The least desirable reason was to evaluate impacted mandibular canine teeth.

Panoramic radiographs are widely used for the diagnosis of pathologies such as retention cysts, polyps and tumors in the maxillary sinus. However, a definitive diagnosis cannot always be made with panoramic radiographs. Determining the state of the maxillary sinuses is important for implant planning. DVT gives us important information on sinus floor augmentation in cases where there is insufficient bone height.¹⁸ DVT gives better results than other radiographs to evaluate odontogenic maxillary sinus inflammation, the spread of periapical lesions to the maxillary sinus, and endodontic-induced maxillary sinus disorders.¹⁹ In our study, DVT was requested from 23 patients to evaluate the sinuses, and these requests consisted of 8 female and 15 male patients. Although it had a rate of 1.5% among all requests, the rate of DVT requested for sinus evaluation was found to be low.

The structure of the bony components of the TMJ, cortical bone integrity, bone formation and destruction in the subcortical bone, developmental anomalies of the TMJ, fractures, and pathological changes such as ankylosis can be better evaluated with DVT compared to conventional radiographs.²⁰ In our study, only 10 patients requested DVT for TMJ evaluation.

Evaluation of root canal morphology, root resorptions, dentoalveolar trauma, dental anomalies, evaluation of periapical lesions, evaluation before endodontic surgery, determination of the position of the broken instrument are the purposes of DVT in endodontics.²¹ A good determination of root canal anatomy directly affects the success of endodontic treatment. Matherne *et al.*²², in a study comparing direct and indirect digital systems with DVT to determine the number of root canals in 72 extracted teeth, stated that endodontists could not find at least one canal in 40% of teeth, despite taking parallel radiographs with digital radiographs. In our study, the Endodontics Clinic requested DVT from 222 patients, and it was seen that 70 of them were in the first place to evaluate the root canal morphology. In the second place, it was determined that a request was made for the evaluation of vertical root fractures. In a case report, Ball *et al.*²³,

they performed root canal treatment in a 64-year-old female patient with the diagnosis of symptomatic apical periodontitis on the right maxillary second premolar tooth, but when the DVT image was taken, they determined that there was vertical bone loss and fracture along the lingual of the root. In another study, Estrela *et al.*²⁴ performed with 48 periapical radiographs and DVT scans in 40 patients, they noted that while DVT scans showed 100% of the lesions, 68.8% of the lesions could be detected on periapical radiographs. In our study, requesting DVT for the evaluation of root resorption is in the 3rd place among the requests made from the Endodontics Clinic.

DVT evaluation requested for the indications of the Pedodontic Clinic consisted of 48 patients. Evaluation of impacted supernumerary and mesiodens teeth was the first among the reasons for DVT requests in this clinic. In addition, DVT was requested for the evaluation of the eruption path of impacted teeth, root resorptions, dental anomalies, and dentoalveolar trauma. Ertaş *et al.*⁸ reported that among the causes of DVT requests, impacted tooth cases were included in the first place in order to determine the direction of eruption, position and whether there was resorption in adjacent teeth. Kolçakoğlu *et al.*²⁵ reported in their study that the most common cause of DVT requests in children was for the purpose of anatomical-morphological evaluation.

Orthodontic Clinic was the clinic that has the least request among the clinics that made the request with 3 patients. Indications for use of DVT in orthodontics include the positions of impacted teeth, root resorption, orthodontic implant placement, evaluation of individuals with cleft lip and palate, three-dimensional evaluation of asymmetries and upper respiratory tract.²⁶ DVT request has never been made from Prosthetic and Restorative Dentistry Clinics.

Conclusions

Today, with the use of DVT in dentistry, its diagnosis and diagnosis capacity has started to develop rapidly. DVT, which enables three-dimensional imaging, enables the evaluation of anatomical structures in the head and neck region with its high-resolution capacity.²⁷ The maxillofacial region is used in the diagnosis and treatment planning of anatomical and pathological structures, evaluation of the temporomandibular joint, implant planning and many other areas. This study shows that the role of DVT in Oral, Dental and Maxillofacial Surgery, Periodontology, Endodontics, Orthodontics and Pediatric Dentistry clinics is important.

Acknowledgment

No funding was received for this study.

Conflicts of Interest

None of the authors of this article has any relationship, affiliation or financial interest regarding the subject or material mentioned in the article.

References

1. Scarfe WC and Farman AG. What is cone-beam CT and how does it work? *Dent Clin North Am* 2008;52:707-730.
2. Scarfe WC, Farman AG and Sukovic P. Clinical applications of cone-beam computed tomography in dental practice. *J Can Dent Assoc* 2006;72:75-80.
3. Mozzo P, Procacci C, Tacconi A, Martini PT, & Andreis IB. A new volumetric CT machine for dental imaging based on the cone-beam technique: preliminary results. *European Radiology* 1998;8:1558-1564.
4. Venkatesh E, Elluru SV. Cone beam computed tomography: basics and applications in dentistry. *J Istanbul Univ Fac Dent* 2017;51:102-121.
5. Scarfe WC, Azevedo B, Toghiani S, Farman AG. Cone beam computed tomographic imaging in orthodontics. *Australian Dental Journal* 2017;62:33-50.
6. Liang X, Jacobs R, Hassan B, Li L, Pauwels R, Corpas L, et al. A comparative evaluation of Cone Beam Computed Tomography (CBCT) and Multi-Slice CT (MSCT) Part I. On subjective image quality. *Eur J Radiol* 2010;75:265-9.
7. Ganz SD. Cone beam computed tomography-assisted treatment planning concepts. *Dent Clin North Am* 2011;55:515-536.
8. Tarım Ertaş E, Kalabalık F. The indications for dental volumetric tomography in a Turkish population sample. *Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi* 2015;24:232-240.
9. Menziletoğlu D, Işık BK and Güler AY. Reasons of cone-beam computed tomography requests in oral and maxillofacial surgery 2019;15:64-69.
10. Özcan M, Keçeli S, Cenk Mehmet H. The comparison of panoramic radiographs and cone-beam computed tomography for vertical bone height in maxillary posterior are. *Yeditepe Dental Journal* 2016;12:39-46.
11. Froum S, Casanova L, Byrne S, Cho SC. Risk assessment before extraction for immediate implant placement in the posterior mandible: a computerized tomographic scan study. *J Periodontol* 2011;82:395-402.
12. Kalpidis CD, Setayesh RM. Hemorrhaging associated with endosseous implant placement in the anterior mandible: a review of the literature. *J Periodontol* 2004;75:631-645.
13. Kaneda T, Minami M, Kurabayashi T. Benign odontogenic tumors of the mandible and maxilla. *Neuroimaging Clin N Am* 2003;13:495-507.
14. Dawood A, Patel S, Brown J. Cone beam CT in dental practice. *Br Dent J* 2009;207:23-28.
15. Akarslan Z, Peker I. Bir diş hekimliği fakültesindeki konik ışınli bilgisayarlı tomografi incelemesi istenme nedenleri. *Acta Odontologica Turcica* 2015;32:1-6.
16. Ahmad M, Jenny J, Downie M. Application of cone beam computed tomography in oral and maxillofacial surgery. *Aust Dent J* 2012;57:82-94
17. De Vos W, Casselman J, Swennen GR. Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: a systematic review of the literature. *Int J Oral Maxillofac Surg* 2009;38:609-625.
18. Naitoh M, Suenaga Y, Kondo S, Gotoh K, Arijji E. Assessment of maxillary sinus septa using cone-beam computed tomography: etiological consideration. *Clin Implant Dent Relat Res* 2009;11:52-58.
19. Zhao Y, Nguyen M, Gohl E, Mah JK, Sameshima G, Enciso R. Oropharyngeal airway changes after rapid palatal expansion evaluated with cone-beam computed tomography. *Am J Orthod Dentofacial Orthop* 2010;137:71-78.
20. Barghan S, Tetradis S, Mallya S. Application of cone beam computed tomography for assessment of the temporomandibular joints. *Aust Dent J* 2012;57:109-118.
21. Özbay Y, Erdemir A. Endodontide konik ışınli bilgisayarlı tomografinin kullanımı. *Kırıkkale Üniversitesi Tıp Fakültesi Dergisi* 2016;18:139-150.
22. Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems in vitro. *J Endod* 2008;34:87-89.
23. Ball RL, Barbizam JV, Cohenca N. Intraoperative endodontic applications of cone-beam computed tomography. *J Endod* 2013;39:548-557.
24. Estrela C, Bueno MR, De Alencar AH, Mattar R, Valladares Neto J, Azevedo BC, De Araújo Estrela CR. Method to evaluate inflammatory root resorption by using cone beam computed tomography. *J Endod*. 2009;35:1491-1497.
25. Solak Kolcakoglu K, Amuk M. Çocuk diş hekimliğinde konik ışınli bilgisayarli tomografi istek nedenleri. *JHS*. 2021;30:68-73.
26. Agrawal JM, Agrawal MS, Nanjannawar LG, Parushetti AD. CBCT in orthodontics: the wave of future. *J Contemp Dent Pract*.2013;14:153-157.
27. Van der Stelt PF. Conebeamcomputertomografie: is meer ook beter? Cone beam computed tomography: is more also better? *Ned Tijdschr Tandheelkd* 2016;123:189-198.