



Pattern and Prevalence of Cone-Beam Computed Tomography Prescription in Tehran, Iran, From 2013 To 2016

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Abstract

Background: Dental images are an integral part of diagnosis and treatment of many oral diseases. Cone-beam computed tomography (CBCT) is more accurate and has less side effects than the conventional imaging methods. This study aimed to assess the prevalence of CBCT prescription and changes in prescription trend from 2013 to 2016 in patients referring to a private oral and maxillofacial radiology clinic.

Materials and Methods: This descriptive study evaluated 9624 cases of CBCT referrals for the reason of referral, source of refer, and patient's age and sex. The pattern of prescribing CBCT was evaluated over four years based on the source of refer and reason of imaging. Data were analyzed by using SPSS software through ANOVA tests ($P < 0.05$).

Results: Out of the studied patients, 45.6% were men and 54.4% were women, with an average age of 47.5 years. The most frequent reason for CBCT prescription was implant site evaluation (94.5%), followed by endodontic reasons (1%). Frequency of other reasons was less than 1%. The patients were most commonly referred by general dentists (37.4%), periodontist (31.1%) and maxillofacial surgeons (21.9%), respectively. An increasing trend was noted in CBCT prescription by both general dentists and specialists for all purposes.

Conclusion: Seemingly, the dentists' knowledge is not adequate about the potential advantages of CBCT imaging system and its superiority over the conventional imaging methods. Therefore, improving the academic level of dental curriculum and educational programs in this regard should be emphasized.

Keywords: Cone Beam Computed Tomography; Oral Radiology; Panoramic Radiography; Prescription Pattern; Prescription Prevalence

Introduction

Combination of conventional x-ray and panoramic radiography is adequate for assessment of most clinical conditions; however, sometimes, radiographic assessment is facilitated by multidimensional images like computed tomography. Most clinicians restrictedly use advanced imaging due to the costs and radiation exposure dose; however, cone-beam computed tomography (CBCT) has provided them with multidimensional images of the maxillofacial area [1].

CBCT is a novel method of radiography in dentistry, which provides three-dimensional (3D) data about the hard and soft tissues without magnification and distortion [2]. This method has remarkably improved the diagnosis and treatment of maxillofacial anomalies and diseases [1], which are increasingly used to choose the appropriate plan for implant treatments [2-4], endodontic treatments [2], assessment of pathoses surgeries [5,6], temporomandibular joint (TMJ) [7] and orthodontic process [2,8], as well as, pre-, peri-, and post-operative evaluations in craniofacial traumas and cranio-

facial reconstructions [9-13]. CBCT also helps locating foreign bodies in soft tissue[14], examining the cleft lip and cleft palate [15], evaluating the depth of dental caries [16,17], restorative dentistry [18], and prostheses [13].

What promotes CBCT over the conventional radiography is its ability in providing accurate 3D information about the imaging region, internal structure and extent of the lesion, which facilitates planning of further measures [19]. CBCT is also superior to conventional computed tomography because of its smaller device size, lower cost and radiation dose [19-21], scanning time and restriction of x-ray beams [2]. Nonetheless, the image noise, and low contrast of the soft tissue are the shortcomings of this method [21].

Despite the introduction of CBCT to maxillofacial radiography in the last decade and its undeniable advantages, this technology is not adequately appreciated. Ever since, several training workshops have been held about the capabilities and options of this technique and its superior benefits over other methods. Yet, no study has ever evaluated the trend of practitioners and clinicians' tendency towards use of this method for different diagnostic targets, according to which, plans can be set to orient the prescription of CBCT images. Considering the advantages of this technology, loss of previous studies on the tendency towards using CBCT technique, and its capabilities in various fields of dentistry, the present study was conducted to evaluate the prevalence of different reasons for prescribing CBCT, and trend of CBCT prescription from 2013 to 2016, in a private oral and maxillofacial radiology clinic.

Materials and Methods

This descriptive cross-sectional study was performed on 9624 CBCT application forms, belonging to patients referring to a private oral and maxillofacial radiology clinic in Tehran, Iran, from 2013 to 2016. The forms were selected on a simple nonrandom sampling basis. A form was filled out for each single patient including the patient's name and age, reason of imaging, referrer's name and specialty, and date of request. The collected information was inserted in datasheets to create a database. To maintain ethical considerations, the patients' and referrer's name was only recorded in datasheets, not in the database.

The prevalence and pattern of prescribing CBCT was analytically analyzed through descriptive and inferential statistics. Each vari-

able was first expressed in descriptive statistics; then, its changing pattern over the years (either increasing or decreasing) was inferentially analyzed. The statistical analyses were done with SPSS software (version 16) through ANOVA test ($\alpha = 0.05$).

Results

Out of 9624 cases referring for CBCT from 2013 to 2016, 54.4% of cases were women (n = 5236) and 45.6% of cases were men (n = 4388). Sex ratio of CBCT prescription was 84; i.e., per each 100 women, 84 men were referred for CBCT. Patients within the age range of 55-60 were the most frequently referred cases, and those within 85 - 90 years were the least frequently referred patients for CBCT. The average age of studied patients was 47.5 years old. The oldest patient was a 90-year-old man referred for imaging for implant site evaluation; and the youngest case was a 5-year-old child for evaluation of tooth eruption (Figure 1).

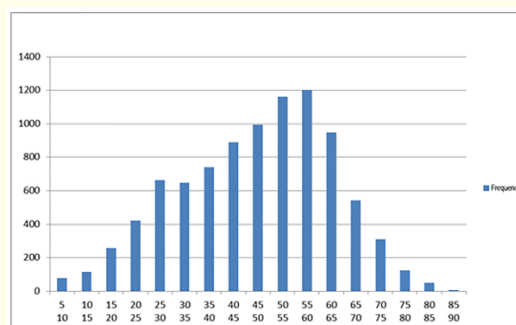


Figure 1: Distribution frequency of cases referring for CBCT based on patients' age.

CBCT was most frequently prescribed by general dentists (37.4%), followed by periodontists (31.1%) and oral and maxillofacial surgeons (21.9%). Other referrers were, respectively, prosthodontists (4.9%), endodontists (1.5%), restorative specialists (1.5%), oral pathologists (0.8%), orthodontists (0.7%), and pediatricians (0.1%) (Table 1).

The most common reason for prescribing CBCT was implant site evaluation (94.5%, n = 9095). Among the remaining 5.5%, endodontic assessment was the most frequent reason. Frequency of other reasons was less than 1%, with 1 to 77 cases (Table 2).

Refer source	Frequency	%
General Dentist	3599	37.4
Periodontist	2998	31.2
Oral and maxillofacial surgeon	2111	21.9
Prosthodontist	467	4.9
Restorative specialist	146	1.5
Endodontist	149	1.5
Oral pathologist	77	0.8
Orthodontist	65	0.7
Oral pediatrician	12	0.1
Total	9624	100

Table 1: Frequency of patients based on the refer source.

Reason	Frequency	%
Implant site evaluation	9095	94.5
Endodontic evaluations	96	1
Paranasal sinus	77	0.8
Periodontic lesions	76	0.8
Temporomandibular joint disorders	67	0.7
Impacted tooth	62	0.6
Landmarks	41	0.4
Pathologic lesions	29	0.3
Cleft palate	20	0.2
Trauma	17	0.2
Edentulism	12	0.1
Extra tooth	9	0.1
Orthodontic evaluations	6	0.1
Remaining root	4	0.04
Navigation	3	0.03
Bone graft	2	0.02
Surgery	2	0.02
Facial asymmetry	2	0.02
Sialolithiasis	2	0.02
Prosthodontic check	1	0.01
Ankylosis	1	0.01
Total	9624	100

Table 2: Frequency of reasons for CBCT imaging.

Primary comparisons revealed that prescribing CBCT had generally increased from 2013 to 2016 (Table 3). This increasing trend was more notable among dental specialists, particularly periodontists (n=2998) (Table 4). CBCT aimed at implant site evaluation was mostly prescribed by periodontists and oral and maxillofacial surgeons (Figure 2).

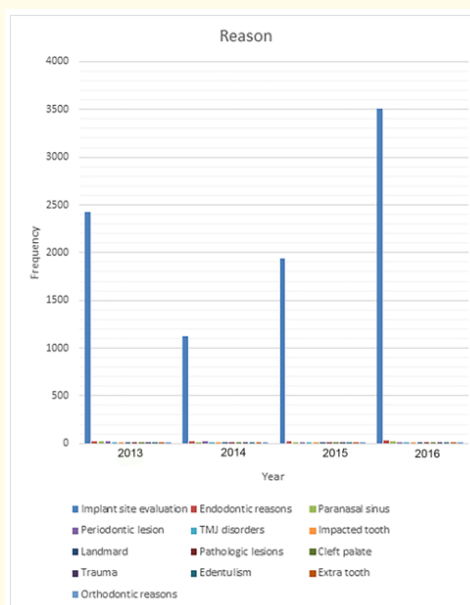


Figure 2: Changing pattern of prescribing CBCT based on the reason.

Year	Dental specialists (%)	General dentists (%)
92	1420 (23.5)	890 (24.7)
93	1498 (24.8)	930 (25.9)
94	1520 (25.4)	980 (27.2)
95	1587 (26.3)	799 (22.2)

Table 3: Changing pattern of requesting CBCT based on the frequency of referrals.

Source of refer	Year				Total
	1392	1393	1394	1395	
General dentist	521	700	1228	1150	3599
Periodontist	481	620	871	1024	2998
Oral and maxillofacial surgeon	343	476	642	650	2111
Prosthodontist	21	38	193	215	467
Restorative specialist	23	30	40	53	146
Endodontist	28	34	38	49	149
Oral pathologist	14	20	21	22	77
Orthodontist	12	19	17	20	65
Pediatric dentist	3	2	3	4	12

Table 4: Changing pattern of requesting CBCT based on the source of refer.

Discussion

The present study found a statistically significant difference between the two sexes in terms of referring for CBCT ($P = 0.013$); women comprising the major portion of requests (54.4%). A study conducted by Kayaoglu, *et al.* [22] in Turkey reported that most of the cases referring for CBCT were women, probably because women are more concerned with esthetics than men. In the present study, the patients' average age was 47.5 years, ranging from 5 to 90. Different age ranges were reported in previous studies [23,24]; yet, most studies reported age range from 40 to 50, which was similar to the present study.

CBCT imaging was mostly requested by general dentists (37.4%), followed by periodontists (31.1%), oral and maxillofacial surgeons (21.9%), and prosthodontists (4.9%). Similarly, Razavi, *et al.* [2] in Yazd (south Iran) found that CBCT was more prescribed by general dentists (44%), followed by oral and maxillofacial surgeons (32.2%). Arnheiter, *et al.* [18] reported that oral and maxillofacial surgeons and periodontists referred more patients for CBCT imaging.

The present study found that CBCT prescription was most common among general dentists for implant site evaluation. It can be due to the increasing number of general dentists trained in implanting and their familiarity with CBCT imaging, in addition to the patients' increasing demand for dental implants. Periodontists and oral and maxillofacial surgeons prescribed CBCT more than other dental specialists, since they are more involved in procedures such as implanting and bone graft surgeries, which requires 3D images like CBCT.

The current study found that the frequency of prescribing CBCT had generally increased from 2013 to 2016. Trained clinicians who are oriented with the advantages of CBCT for implanting (lower radiation dose, less artifacts, and more advanced softwares), mainly prefer CBCT over other conventional imaging methods such as spiral CT. As demands are increasing for implant treatments, CBCT is being increasingly used. Undoubtedly, in near future, application of this imaging method would remarkably progress in dentistry.

The most frequent reason for CBCT was implant site evaluation (94.5%). Similar result was reported by Miles (2006) [25], who studied five imaging centers in different states of America. Given the significance of adjacent anatomic landmarks such as the inferi-

or mandibular alveolar canal and maxillary sinus, bone evaluation and measurement requires precise 3D imaging technique, which provides images of high resolution without magnification and superimposition or distortion, and allows image reconstruction in different planes. These all justify the high prevalence of CBCT prescription for implant site evaluation as the first and most predictable application of CBCT in dentistry [25].

In the present study, the second common referrer specialists were endodontists (1%), who requested CBCT to assess presence of subcanals, roots morphological complexity, vertical and horizontal fractures, internal or external resorption, and quality of endodontic treatment. Other reasons comprised less than 1% of cases and were aimed at evaluation of paranasal sinus, periodontal lesions, TMJ disorders, impacted teeth, anatomical landmark location, pathological lesions, cleft palate, and trauma, respectively.

Pattern of CBCT prescription was first investigated by Shinoda, *et al.* [26] in 2887 cases in Nihon University Dental Hospital. They found that evaluation of implant site (53%) and impacted tooth (11%) were the most common reasons for taking CBCT images. Other reasons were TMJ disorders, apical disease, extra teeth, and other pathoses. In that study evaluation of impacted teeth was the second common reason for CBCT; whereas, the frequency this reason was only 0.6% in the present study. This might be due to the limited familiarity with the potential diagnostic advantages of CBCT. Limitations of conventional radiography in illustrating 3D objects and showing the exact relation between the impacted tooth and adjacent structures can be a strong reason for using CBCT instead of conventional radiography to detect impacted teeth [26].

Razavi, *et al.* [2] reported implant site evaluation (88.5%) as the most frequent reason for CBCT imaging, followed by wisdom tooth surgery, evaluation of maxillary canine tooth impaction, root resorption, cleft palate, extra tooth examination, foreign bodies in sinus, post-orthodontic sensitivity, as well as impacted tooth and associated pathosis [2]. TMJ disorder was a rather common reason for CBCT imaging as reported by Arnheiter, *et al.* (16%) [18], and Shinoda, *et al.* (8%) [26]. However, in the current study, TMJ disorders were the reason for CBCT in only 0.7% of cases. Probably, clinicians prefer to evaluate TMJ disorders through conventional imaging methods, which are simply available and known, besides that the patients with TMJ disorders refer to specialists other than

dentists such as ENT. Moreover, the low contrast of soft tissue in CBCT images poorly illustrate the soft components of TMJ [18,26].

White and Pharoah's Oral Radiology (2009) is considered as the first reference of radiology with a specific chapter on CBCT [21]. According to the Iranian Association of Oral and Maxillofacial Radiology, 57 general international congress and 12 congress on oral radiology were held in Iran from 2008 to 2017, which has covered CBCT. Moreover, educational curriculum on CBCT device was held in 2013 in Iran. They all concluded that holding congresses totally or partially dedicated to CBCT could encourage the clinicians and private and public bodies to use CBCT. Undoubtedly, CBCT have improved the efficacy of diagnosis and treatments in dentistry [27].

Cone-beam computed tomography is now quite a common imaging method. The increasing use of CBCT by clinician, advantages of this method, more precise imaging and less artifacts compared to previous methods have highly helped the diagnosis and treatment of oral diseases. These all have encouraged the clinicians and private and public radiology centers towards using this imaging technique. It is not far-fetched that all dental centers be equipped with CBCT device and widely use it.

According to the present findings, it is suggested to set a curriculum that elevates the clinicians' attitude about the diagnostic significance, advantages, and different implications of CBCT. Moreover, training and retraining courses can be held on novel imaging techniques in dentistry to improve and update the clinicians' knowledge. Further studies are recommended to investigate other indications of this imaging technique, the reasons for not using CBCT in dentistry, and compare the costs and insurance coverage of conventional imaging methods and CBCT. Research is also required to evaluate prevalence of reasons for requesting CBCT imaging, considering other geographical locations and different reasons in those regions.

Conclusions

The present study found that in this private radiology center, implant site evaluation was the most common reason for prescribing CBCT images, which were most frequently requested by general dentists, followed by periodontists and oral and maxillofacial surgeons. CBCT has more applications and advantages than the conventional methods. The trend of prescribing CBCT by general dentists was found to be increasing. Training the clinicians about

the advantages and applications of CBCT can effectively improve the diagnosis and treatment of oral diseases.

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