

A Cross Sectional Survey of Availability and Cost of Cone Beam Computed Tomography and Oral and Maxillofacial Radiology Services in Riyadh, Saudi Arabia

Ra'ed Al-Sadhan*

Associate Professor, Department of Oral Medicine and Diagnostic Sciences, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

***Corresponding Author:** Ra'ed Al-Sadhan, Associate Professor, Department of Oral Medicine and Diagnostic Sciences, College of Dentistry, King Saud University, Riyadh, Saudi Arabia.

Received: July 24, 2021; **Published:** August 28, 2021

Abstract

Aim: The aim of this study was to assess availability and economic cost of oral and maxillofacial radiology services in Riyadh, Saudi Arabia.

Methods: A cross-sectional survey was made of a representative sample of 194 dental centers in Riyadh.

Results: The response rate was 29.4% and 194 dental centers were surveyed. All the centers who replied had intraoral radiography and only 63.1% had occlusal radiography. Almost all (98.25%) had panoramic radiography and most of them had cephalometric radiography (91.2%). Only 19% had CBCT. The average price for an intraoral radiograph was 14.27 US\$, 19.12 US\$ for an occlusal radiograph, 52 US\$ for a panoramic radiograph and 65.2 US\$ for a cephalometric radiograph. The average costs of the different field of view CBCT examinations ranged from 117.59 US\$ for small, 147.66 US\$ for medium and 193 US\$ for the large.

Conclusion: Unlike conventional intraoral and extraoral radiographic examinations which are widely available at most dental clinics in Riyadh, most dental clinics do not have CBCT units and the examination costs much more and has a wider range.

Keywords: *Dental Health Services; Radiography; Dental; Cone Beam Computed Tomography; Costs and Cost Analysis; Diagnostic; Oral Health*

Abbreviations

CBCT: Cone Beam Computerized Tomography; FOV: Field of View; SAR: Saudi Riyals; US\$: United States Dollars; CCD: Charged Couple Device; CMOS Complementary Metal-Oxide-Semiconductor; PSP Photostimulable Phosphors Plates

Introduction

Since the introduction of cone beam computerized tomography (CBCT) to dentistry in 1998 [1], the need for such imaging modality has developed in the different aspects of dental practice [2]. The main advantage of CBCT is the relatively low radiation dose that a patient is exposed to in order to achieve the needed diagnostic tasks compared to multidetector computed tomography that was the imaging modality of choice for 3D imaging before CBCT became widely available in dentistry [3]. The radiation dose can be further reduced by

adjusting the field of view (FOV) of the CBCT examination to the area of interest in the patient jawbones and by customizing the exposure parameters to fit the diagnostic task needed in each patient [4]. Guidelines for clinical use of CBCT and selection criteria were developed as more scientific evidence for its appropriate use became available [5].

Since the installation of the first CBCT scanner in Riyadh, Saudi Arabia in November 2008, [6] there was a rapid increase in its utilization nationwide, but it is not clear to what extent. A survey of dentists in three countries in the region (Saudi Arabia, Egypt and Jordan) reported that 78% either had CBCT in their clinic or had access to CBCT in the same city [7]. However, no specific data is available for Riyadh, Saudi Arabia and no previous studies reported on the availability and financial cost of oral and maxillofacial radiology services in Riyadh, Saudi Arabia.

Aim of the Study

Thus, the aim of this study was to assess availability and economic cost of oral and maxillofacial radiology services in Riyadh, Saudi Arabia.

Materials and Methods

A self-administered e-survey was made for the dental department of 9 of the 16 main governmental hospital in Riyadh (part of Ministry of Health, Military Hospitals, Security Forces and National Guard), all public and private dental colleges in Riyadh city (six dental schools) as well as a selected representative sample of private dental centers in Riyadh city. According to Alsalleeh, *et al.* there are 236 dental centers in Riyadh city [8]. Therefore, a representative sample size estimation of 53 private centers was determined as minimum number to be surveyed after considering 95% confidence level and 5% confidence interval. The selected sample of private dental centers was selected to represent private dental centers in Riyadh city from the interactive map of Riyadh on the Nine-Tenths Portal by Zaad, an online service by the Saudi Human Resources Development Fund that provide interactive reports on different services and activities available in Saudi Arabia [9]. The data in the portal was up to date till 2019 and it was retrieved from the portal on 15 July 2020. One private dental center was randomly selected from each of the districts. For the highly populated districts (more than 40000 people per km²) an additional center was selected. The centers were selected from the list in the database using Google random number generator. The contact information of the centers was retrieved then the centers were contacted by phone. If the contacted center failed to respond within a week, a replacement center was randomly selected from the same district. The information was collected using an online form that was designed and piloted to collect information from the selected respondents that included text and pictorial questions about the name and location the dental center, availability and cost the different oral and maxillofacial radiographic examinations (the cost of the service as in the center pricelist for cash patients and without taxes or any bundled offers or package services). The survey form included text in both English and Arabic languages. The pictures that were used were intended to further illustrate each question. A dentist in each location was asked to fill the online form. If more than one response were submitted for the same location, they were compared and if they were identical, one of them was omitted, if however, there was discrepancy between them, the clinic was contacted again to resolve this discrepancy. In total, 194 locations were surveyed in Riyadh city.

Results and Discussion

Out of the 194 dental centers that were surveyed in this study only 57 centers completed the full survey (29.4%) while 137 centers (70.3%) only replied regarding the availability and pricing of CBCT examinations without providing information on the rest of oral and maxillofacial radiographic examinations. All the centers who replied to the full survey had intraoral radiographic examination in the form of periapical and bite-wing radiography and only 36 centers (63.1%) had occlusal radiography. Almost all (56 centers, 98.25%) had panoramic radiography and most of them had cephalometric radiography (52 centers, 91.2%). Out of the 194 centers only 37 centers (19%) had CBCT examination services. Table 1 shows the cost of the different oral and maxillofacial radiographic examinations reported by the participants in this study.

	Intraoral Radiography		Extraoral Radiography		Cone Beam Computed Tomography		
	Periapical/ Bitewing	Occlusal	Panoramic	Cephalometric	Small FOV, Quadrant	Medium FOV, Single Arch	Large FOV, Double Arches
Average	53.5 SAR 14.27 US\$	71.7 SAR 19.12 US\$	195 SAR 52 US\$	244.5 SAR 65.2 US\$	441 SAR 117.59 US\$	553.75 SAR 147.66 US\$	723.75 SAR 193 US\$
Std Dev	17.8	34.6	69.6	92.5	155.4	238.1	359.6
Max	100 SAR 26.67 US\$	150 SAR 40 US\$	300 SAR 80 US\$	400 SAR 106.66 US\$	750 SAR 200 US\$	1200 SAR 320 US\$	1800 SAR 480 US\$
Min	25 SAR 6.67 US\$	25 SAR 6.67 US\$	60 SAR 16 US\$	90 SAR 24 US\$	160 SAR 42.66 US\$	265 SAR 70.66 US\$	300 SAR 80 US\$

Table 1: Cost of oral and maxillofacial radiographic examinations in Saudi Riyals (SAR) and US Dollars (US\$) in Riyadh (FOV: Field of view).

The response rate in this study was relatively low (29.4%) as many of the contacted private centers declined to provide full information on the prices of their services, presumably due to concern about revealing information to other competitors in the same market. As a result, the number of surveyed centers in this study had to be increased to achieve the targeted sample size. The results of this study indicate the availability of the different intraoral and extraoral radiographic examinations (other than CBCT) for dental care providers in Riyadh. This is similar to the results reported by Faraz in 2014 in Jeddah, Saudi Arabia [10]. However, there was one exception related to occlusal radiographic examinations which were available in only 63.1% of the surveyed sample. This could be due to the shift in the oral radiology practices from analog film radiography to solid state digital radiographic sensors in the form of charged couple device (CCD) sensors or complementary metal-oxide-semiconductor (CMOS) sensors in which there is no appropriate sized sensors suitable for occlusal radiographic examinations of adult patients comparable to the size-4 intraoral conventional films or photostimulable phosphors (PSP) plates that have an active area of 57 x 76 mm.

The percentage of dental care providers that had CBCT service in this study was 19% which is much less than that reported previously by Zain-Alabdeen and El Khateeb in 2018 who found that 78% of dentists had access to CBCT in a selected sample from Saudi Arabia, Egypt and Jordan [7]. This difference can be explained by the fact that the previous study result included all dentists who had access to CBCT in the same city even if it was in an off-site referral clinic while this study only reported the clinics that actually had the CBCT units and were operating them and charging patients for the service. It is hypothesized from the results reported in both these studies that the majority of dentists who utilize this specialized radiographic examination send their patients to referral clinics rather providing this service in office, perhaps due to the high cost of purchasing and operating such equipment.

The prices of the different oral and maxillofacial radiology examination reported in this study had a wide range especially CBCT which had a much higher cost and there was a wide range of prices between the different centers. Similar observations were made in other healthcare systems [11]. It is thought that a large part of the total cost of CBCT was because of high capital cost for equipment, maintenance and accommodation, being 43% of the total cost per examination as compared for the conventional oral and maxillofacial radiographic examination which represent only 17% of the total cost [12]. There is a growing awareness that diagnostic investigations should be evaluated not only on their intrinsic qualities (essentialism) but also based on their consequences for patients' health and the use of health care resources (consequentialism). Acceptable diagnostic accuracy, though important, is generally not sufficient for demonstrating benefits from diagnostic testing [13].

Conclusion

Unlike conventional intraoral and extraoral radiographic examinations which are widely available at most dental clinics in Riyadh, most dental clinics do not have CBCT units and the examination costs much more and has a wider range.

Conflict of Interest

The author declare that they have no conflict of interest.

Authors' Contributions

The author contributed to the study conception and design. Material preparation, data collection and analysis were performed by Ra'ed Al Sadhan. The first draft of the manuscript was written by Ra'ed Al Sadhan. No other contributing authors are involved to comment on previous versions of the manuscript. The author read and approved the final manuscript.

Funding Support

This research was not supported or funded.

Ethics Approval

An ethical approval from the local IRB was given for this research project (King Saud University IRB project approval No. E-20-562).

Bibliography

1. Mozzo P, *et al.* "A new volumetric CT machine for dental imaging based on the cone-beam technique: preliminary results". *European Radiology* 8.9 (1998): 1558-1564.
2. Nasseh I and Al-Rawi W. "Cone Beam Computed Tomography". *Dental Clinics of North America* 62.3 (2018): 361-391.
3. Ludlow JB, *et al.* "Effective dose of dental CBCT-a meta analysis of published data and additional data for nine CBCT units". *Dentomaxillofacial Radiology* 44.1 (2015): 20140197.
4. European Commission. Radiation protection 172. Evidence based guidelines on cone beam CT for dental and maxillofacial radiology. Luxembourg: Office for Official Publications of the European Communities (2012).
5. Horner K, *et al.* "Guidelines for clinical use of CBCT: a review". *Dentomaxillofacial Radiology* 44.1 (2015): 20140225.
6. Aldrees A, *et al.* "King Saud University, College of Dentistry". 1st edition. Riyadh Saudi Arabia pp. 21-22, Published by College of Dentistry, King Saud University (2008).
7. Zain-Alabdeen EH and El Khateeb SM. "Comparison of knowledge and perspectives toward cone-beam computed tomography among dentists in three Middle East regions: A cross-sectional study". *Saudi Journal of Oral and Dental Research* 5 (2018): 3-10.
8. Alsalleeh F, *et al.* "Analyzing private dental clinics in Riyadh City, Saudi Arabia". *Saudi Dental Journal* 30.1 (2018): 70-73.
9. Saudi Human Resources Development Fund, 9/10ths Portal by Zaad (2020).
10. Faraz N. "Survey of radiography, radiographic equipment and radiation protection in Jeddah, Saudi Arabia". *Journal of Oral and Maxillofacial Radiology* 2 (2014): 44-51.

11. Christell H., *et al.* "SEDENTEXCT consortium. Variation in costs of cone beam CT examinations among healthcare systems". *Dentomaxillofacial Radiology* 41.7 (2012): 571-577.
12. Christell H., *et al.* "SEDENTEXCT consortium. A framework for costing diagnostic methods in oral health care: an application comparing a new imaging technology with the conventional approach for maxillary canines with eruption disturbances". *Community Dentistry and Oral Epidemiology* 40.4 (2012): 351-361.
13. Bossuyt PMM. "Evidence-Based Medical Testing. Developing Evidence-Based Reimbursement Recommendations for Tests and Markers". In: *Medische Tests (Beoordeling Stand van de Wetenschap en Praktijk)*. Publicatienummer 293. Diemen: College voor Zorgverzekeringen (Dutch Health Care Insurance Board) (2011).

Volume 20 Issue 9 September 2021

©All rights reserved by Ra'ed Al-Sadhan.