

## ORIGINAL ARTICLE

# A cross-sectional survey of dentists' use of digital radiographic techniques in Riyadh, Saudi Arabia

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### Abstract

**Introduction:** Undergraduate oral and maxillofacial radiology curricula are currently undergoing a reform process that is moving toward digital-based radiology that requires dedicated resources to train dental students to the field experience. It is not known if the time is appropriate to totally shift from training students on conventional analog film-based radiology to training them on digital images and the choice of digital system in intraoral and extraoral radiography.

**Aim:** The aim of this study is to assess availability and utilization of the digital radiographic techniques by dental clinics in Riyadh, Saudi Arabia, using a cross-sectional descriptive, epidemiological survey.

**Materials and Methods:** The study included dental departments of nine main governmental hospitals, six dental schools in Riyadh and a representative selected sample of the private dental clinics in Riyadh that included 40 dental clinics. A self-administered e-survey regarding the use of analog or digital radiographic intraoral and extraoral techniques was made. Descriptive statistics are reported in forms of means and range.

**Results and Discussion:** For intraoral radiographic examinations, most clinics (90.9%) used digital systems. Solid-state detectors such as charge-coupled device (CCD) and complementary metal oxide semiconductor sensors were the most popular type digital intraoral sensors (94%) and only 13 locations (26%) used digital photostimulable phosphors plates. For panoramic radiography, almost all (98.1%) used digital systems. Again, the solid-state detectors were the most common digital panoramic system (96.4%). Most respondents had a digital information system to store, retrieve, and display digital radiographs (92.7%), whereas only four locations (5.9%) used hard-copy films or paper prints.

**Conclusion:** Digital imaging is more common than film-based imaging in intraoral radiography in and panoramic radiography in the different dental care delivery sites in Riyadh, Saudi Arabia.

**Key words:** Dental, digital, education, in-service training, needs assessment, panoramic, pre dental, radiography, staff development

### Introduction

Undergraduate oral and maxillofacial radiology curricula are currently undergoing a reform process that is moving away conventional film-based imaging, chemical processing and conventional paper dental records toward digital imaging, electronic dental records with dedicated information systems for image archive,

communication and display. This change is driven by the recent adoption of these systems in the dental practice worldwide and in Saudi Arabia.<sup>[1,2]</sup> Digital intraoral and panoramic imaging have become increasingly

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common worldwide and have replaced conventional analog film imaging to varying degrees.<sup>[3-12]</sup> In Sweden, 98% of the dentists had made the transition to digital intraoral radiography and 90% used digital panoramic radiography.<sup>[5,6]</sup> Digital imaging was used by 36% of dentists in Germany,<sup>[12]</sup> 49% in England, and 38% in Belgium.<sup>[4]</sup>

There are 16,887 licensed dentists in the Saudi Commission for Health Specialties database as of December 2016; most of them are registered as general dentists (70%). About 70% of them are practicing in the private sector and 30.9% of them work in Riyadh.<sup>[13]</sup> There are 236 private dental clinics registered in Riyadh with 70.5% general dentistry (70.5%) practicing in these clinics.<sup>[14]</sup> In 2003, only 5.7% of Saudi dentists reported using intraoral digital sensors.<sup>[15]</sup> A survey in 2014 reported that 79% of dentists in Jeddah, Saudi Arabia, used conventional analog films, digital imaging was not common as only 17% used digital solid-state detectors, about 4% used digital phosphor plates and 20% used computer monitors to view intraoral radiographs.<sup>[16]</sup>

Currently, oral radiology course contents in most Saudi curricula of bachelor dental degrees, dental hygiene and dental assisting training programs include contents regarding training students to be competent in performing dental radiographic examination using both analog as well as digital imaging (in solid-state detectors and phosphor plates). To continue to train dental students in both analog film imaging in intraoral and extraoral radiography in addition to digital imaging, would require dedication of valuable time in curriculum that will be spent to cover both contents that have different learning and teaching strategies and as a result, varying resources and operations are required to be set up (such as films, intensifying screens, dark rooms, chemical processors). These conventional imaging techniques will have to be operated for clinical training of student parallel to the digital imaging techniques already in main use in the clinics of these dental schools. The argument for including both analog and digital imaging clinical training is that, it is not clear which imaging modality the graduate will be eventually using when he/she practices dentistry in the field after graduation which is the rationale of this study. No previous studies reported on the use of digital radiographic techniques in Riyadh, Saudi Arabia. Thus, the aim of this study is to assess availability and utilization of the digital radiographic techniques by dental clinics in Riyadh, Saudi Arabia using a cross sectional descriptive epidemiological survey.

## Materials and Methods

An ethical approval from the local institutional review board (IRB) was given for this research project (King Saud University IRB project approval No. E-20-562) and a self-administered e-survey was made of the dental department of the nine 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 sample of private dental centers in Riyadh city that consisted of forty private dental centers. According to Alsalleeh *et al.*, there 236 dental centers in Riyadh City.<sup>[14]</sup> Therefore, a sample size of 53 centers were determined after considering the 95% confidence level and 5% confidence interval. The participants were selected to represent private dental centers in Riyadh city from 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.<sup>[17]</sup>

Data were retrieved from the portal on July 15, 2020 and one private dental center was randomly selected from each city district that was listed in the database by Google random number generator. The contact information of the center was retrieved then the center was contacted by phone in the period from August 18 to September 15, 2020. If the contacted center failed to respond within a week, a replacement center was selected and contacted. The information was collected using an online survey designed with Google Forms (<https://forms.gle/YtUdWq2rvZiw8k2A8>). The selected respondents that included text and pictorial multiple choice questions about the name and location the dental center, type of intraoral radiographic examination: digital or analog and if digital, wither it is solid state: charged-couple device sensor (CCD)/complementary metal oxide semiconductor (CMOS) sensor or photostimulable phosphors (PSPs) plates-based system (PSP). The question regarding availability and type of panoramic radiographic examination similarly included options of analog, CCD/CMOS or PSP systems. Finally, the survey included a question on the availability of information system to store and display digital images. Respondents were instructed to choose all responses that apply and not necessarily only one option. The survey form was written in both English and Arabic languages in the same page. The pictures that were used were intended to further illustrate each question or option.

The validity of the survey form was tested in a pilot sample that consisted of 2 dentists from dental

departments at hospitals, 2 dentists from universities, and 4 dentists from private dental centers. The dentists in the piloted group were asked to complete the survey form online then a telephone interview was conducted with each respondent to verify the validity of the form. Necessary modifications were made, and then, the form was retested until data collected from the form were found to be an accurate representation of the participant response. After ensuring the survey form validity, a dentist in each selected location was asked to fill the online form and if more than one responses 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 site was contacted again to resolve this discrepancy. In total, 55 locations were surveyed in Riyadh city. Descriptive statistics were reported in forms of means and range.

## Results

For intraoral radiographic examination, 50 locations used digital intraoral radiography (90.9%). Six locations (10.9%) used conventional analog films, Rigid solid-state digital sensors (CCD/CMOS sensors) were the most popular type of digital sensors as 47 (94%) locations used them out of the 50 locations that used digital intraoral radiographic examination and only 13 locations (26%) used PSP systems. Among the locations that used digital intraoral radiography, seven respondents (14%) used both solid-state detectors (CCD/CMOS sensors) as well as PSP plates. All respondents provided panoramic radiographic examinations (only one did not offer this type of radiographic examination). The majority of respondents (53, 98.1%) used digital panoramic units while only one private clinic (1.9%) used film-screen combination panoramic system. Rigid solid-state digital sensors (CCD/CMOS sensors) were the most popular type of digital sensors in panoramic examinations as 53 (96.4%) locations used them out of the 53 locations that used digital intraoral radiographic examination and only three locations (5.6%) used PSP systems for panoramic radiography. All the locations that used analog intraoral and panoramic examinations were private clinics while all of the main hospitals and dental schools used digital intraoral and panoramic radiographic systems in their clinics. Most respondents had a digital information system to store, retrieve, and display digital radiographs (51 locations, 92.7%), while only 4 private dental clinics (7.3%) used hard-copy film or paper prints. Table 1 summarizes the results of the survey.

## Discussion

The results of this survey show that dental care providers in Saudi Arabia have shifted to digital imaging to a great extent and this shift was observed in all the different types of dental practices. This shift seems to have occurred over a relatively short time as in 2003 only 5.7% of Saudi dentists reported using intraoral digital sensors,<sup>[15]</sup> then in 2014 a survey reported that 21% of dentists used digital imaging.<sup>[16]</sup> This change of practice will require that the dental care providers acquire the relevant clinical skills through on-the-job training and highlights the need for continuing medical education and training programs targeted at the proper utilization of the different digital imaging modalities in intraoral and extraoral radiographic examination. Then when a digital image is produced, the dentists and the dental team need to be trained to become competent in digital image processing, archiving, communication, and retrieval. This should improve the quality of the digital images acquired, to arrive at the accurate diagnosis, aid in the formulation of appropriate treatment plan and reduce radiation exposure to the patients.

Since the use of analog film-based imaging was found to be uncommon (only 10.9% in intraoral radiography and 1.9% in panoramic radiography), the limited time and resources available in the dental curricula of bachelor of dentistry programs as well as dental hygiene and dental assisting programs should be completely dedicated to training student on digital image acquisition, processing, and interpretation. This training should also include proper image storage and communication. The few location still using analog film-based radiographic examinations in Riyadh will likely convert to digital imaging in the near future and at this rate of conversion, it is expected that such method of imaging will rarely encounter by the graduates of dental educational programs and should be the exception and considered an equal practice alternative. If a graduate of a dental educational program ended up in a place of practice where only analog radiographic examinations are used, this training need can be met by continuous medical education and training specifically designed for this purpose offered by the employers and the professional dental organizations.

The results of this study are applicable to Riyadh city, which is a limitation of the study. The results are hence not generalizable.

## Conclusion

Digital imaging is more common than film-based imaging in intraoral radiography in and panoramic

**Table 1: Summary of the results of the survey of the use of digital radiographic examinations in Riyadh private dental clinics, main hospitals and dental schools**

Type of intraoral radiographic examination system					Type of panoramic radiographic examination system				Type of digital images storage and display	
Digital, n (%)	Analog, n (%)	Rigid, n (%)	PSP, n (%)	Both, n (%)	Digital, n (%)	Analog, n (%)	Rigid, n (%)	PSP, n (%)	IT system, n (%)	Print, n (%)
50 (90.9)	6 (10.9)	47 (94)	13 (26)	7 (14)	53 (98.1)	1 (1.9)	53 (96.4)	3 (5.6)	51 (92.7)	4 (7.3)

PSP: Photostimulable phosphors plates, IT: Information technology

radiography in the different dental care delivery sites in Riyadh, Saudi Arabia. In future, there is a need to study the available radiographic technique for dentists practicing in other cities or ruler areas. Despite digital imaging is predominant, blended methods should be used to train the dentists during their studies to make them competent for practicing both digital and conventional dental radiography.

#### Availability of data and material (data transparency)

Data and material are available upon request. The survey form is available online at <https://forms.gle/YtUdWq2rvZiw8k2A8>.

#### Code availability (software application or custom code)

Not applicable.

#### 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).

#### Consent to participate

Not required as per ethical approval of the local IRB of this research project (King Saud University IRB project approval No. E-20-562).

#### Consent for publication

Not applicable. No data specifically related to any human subject is presented for the publication in this manuscript.

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#### Conflicts of interest

There are no conflicts of interest.

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