

## Dentist Perceptions on Dental-Radiodiagnosis Using Smartphone: Crossectional study

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### Abstract

Interpretation and radiodiagnosis are the most crucial part of dental radiographic examination. Radiodiagnosis will be used further in supporting the diagnosis and planning on disease treatment. Smartphone is currently the major communication tool with features that can be used in interpretation and radiodiagnosis. It is estimated that many dentists have used smartphones for various practical purposes. This study aims to obtain an overview of the perception of dentists in Jember Regency on smartphone-based dental radiodiagnosis.

This cross sectional study involved 65 dentists in Jember, East Java, Indonesia taken by purposive sampling method. The sample inclusion criteria are: have at least one year of work/practice experience, and are willing to be respondents. The variable studied was the dentists' perception of smartphone-based dental radiodiagnosis. The research instruments were Google Form questionnaires which were distributed via Whatsapp. Perception assessment was carried out using a Likert scale with a score range of 1 – 5. The total perception score was calculated by multiplying the Likert scale score with the number of respondents. The total perception scores obtained were then grouped into 5 categories: very good, good, fair, poor, and very poor. The data obtained were analyzed using descriptive statistics.

The results of the study found that the number of respondents was 40 general dentists, 5 specialist dentists, and 20 dentists with a master's or doctoral education degree. The number of respondents with 1-5 years of practice experience was 10, 7 respondents with 6-10 years of practice experience, and more than 48 respondents with 10 years of practice experience. Perceptions of dentists in Jember Regency regarding smartphone-based dental radiodiagnosis based on respondents and questionnaire assessments have a good category. The conclusion of this study is that the perception of dentists in Jember Regency on smartphone-based dental radiodiagnosis is good.

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### Introduction

Radiographic examination plays a very important role in dental practice to support diagnosis, planning on treatment, and evaluation of treatment outcomes. Radiographic examination is needed by dentists to make an image of the condition of certain body structures of patients that cannot be observed directly on clinical examination. Interpretation of radiographic examination results is a process consisting of many stages starting with the

identification of abnormalities in the radiograph,<sup>1</sup> or a process to reveal all information contained in the radiograph.<sup>2</sup> The purpose of interpretation is to identify the presence or absence of a disease, to provide information on the extent of the disease, and to establish a differential diagnosis.<sup>2</sup> The process of interpretation and radiodiagnosis is very important for dentists to understand because it will affect their definitive diagnosis, which will affect the accuracy of their treatment.

Science and technology in the field of information and communication has been developing rapidly nowadays. One of the most widely used means of communication in the world is a cell phone or smart phone. In today's era it is very difficult to say who is not using a smart phone.<sup>3</sup> In medical practice, cell phones are becoming increasingly common, with an

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estimated 87% of physicians using smartphones in their workplace,<sup>4</sup> and dentists are no exception. Smartphone is a device designed to combine communication capabilities, information management, internet access, and entertainment needs to be made through one device only.<sup>5</sup> Smartphones are multifunctional mobile phones that can be used for browsing, navigating and running small computer programs called applications.<sup>6</sup> In relation to the practice of dentistry, smartphones can be a means to support dentists in performing dental care. Among the benefits used are for interpretation and radiodiagnosis purposes in order to find abnormalities (avoiding inattentive bias) and possible diseases suffered by patients.<sup>7</sup> The use of smartphones in radiodiagnosis of disease is made possible by the presence of high-capacity cameras and the presence of image processing features such as auto focus, digital zoom, optical zoom, and other features. In their operations, the features provide facilities to adjust the light, the contrast, the size of the object (enlarging or reducing the image), the transparency, opacity of the image, etc. All of these features are very helpful in interpretation and radiodiagnosis.

Predictably, smartphones in dental practice are widely used by dentists; some of which may have been utilized for interpretation and radiodiagnosis. The perception of dentists regarding smartphone-based radiodiagnosis interpretation has not been known yet. Perceptions are influenced by factors that affect individuals in different ways depending on various aspects, such as age, gender, marital status, socioeconomic status, educational level, occupation, family, peers, colleagues, culture and mass media.<sup>8,9</sup> This research is a preliminary study and as a support for research related to the use of information technology in the practice of medicine and dentistry.

### Materials and methods

This observational study used cross sectional design. The research population was dentists in Jember Regency. By searching through the Indonesian Dentist Association (PDGI) Jember Branch, 203 dentists have been identified. Of the total dentist population, part of them actively practice and others do not. The sample size was determined by the Slovin formula, and a minimum sample size was 40

respondents, taken by purposive sampling. The sample inclusion criteria are: dentists with active practicing in Jember, have a minimum of one year of work/practice experience, and are willing to be respondents. The variable studied was the dentists' perception i.e. the dentist's perspective on the interpretation and radiodiagnostic process using smartphone. The research instrument was Google form questionnaires which were distributed online through WhatsApp application. The initial activity was to collect data on prospective respondents in coordination with the Indonesian Dentist Association (PDGI) Jember branch. Questionnaire data from respondents would be recorded automatically and could be accessed directly.

The assessment of respondents' perceptions was carried out using a Likert scale as in the research by Rajalatchumi et al. with 5 criteria, namely strongly agree = 5, agree = 4, undecided = 3, disagree = 2, strongly disagree = 1 (for favorable questions), while for the unfavorable questions are strongly agree = 1, agree = 2, undecided = 3, disagree = 4, and strongly disagree = 5.<sup>10</sup> The total perception score was calculated by multiplying the Likert scale score with the number of respondents. The results were then grouped into 5 categories, namely: very good, good, fair, poor, and very poor. Data analysis was performed using descriptive statistics.

## Results

### 1. Respondents' profile

Characteristics	Sub-Characteristics	n	%
Education	General Dentist	40	61.54
	Radiology-Specialist	0	0
	Other Specialists	5	7.69
	Master's/Doctor	20	30.77
Total		65	100

**Table 1.** Distribution of respondents based on educational degree.

Table 1 and table 2 show that the educational level of most respondents is general dentist by 61.54%, while the most work experience is more than 10 years, by 73.85%.

Characteristics	Sub-Characteristics	n	%
Length of Work/Practice	1 – 5 years	10	15.38
	6 – 10 years	7	10.77
	>10 years	48	73.85
Total		65	100

**Table 2.** Distribution of respondents based on length of work/practice.

## 2. Smartphone usage data

Smartphone	n	%
Smartphone use for dental radiographic diagnosis	Always	0
	Often	7
	Sometimes	44
	Never	14
		80
		20

**Table 3.** Distribution of respondents based on smartphone use in dental practice.

## 3. Perception of Dentists in Jember on dental-radiodiagnosis using smartphone based on questionnaire assessment

The data in table 4 above show that the perception of dentists in Jember on dental-radiodiagnosis using smartphones is good with a score of 240. In general, for the favorite questions such as whether smartphones help or facilitate radiodiagnosis, whether radiodiagnosis becomes easier and faster, the respondents have a perception in “good” category. Meanwhile, for unfavorable questions such as whether the use of smartphones for radiodiagnosis is more difficult and the results are at risk of being manipulated, dentists have fair perception.

## 4. Perception of Dentists in Jember on dental-radiodiagnosis using smartphones based on respondents

Perception Category	n	%
Very good	4	6.15
Good	44	67.69
Fair	17	26.15
Poor	0	0
Very poor	0	0
Jumlah	65	100

**Table 5.** Distribution of dentists' perceptions in Jember regarding interpretation/ radiodiagnosis using smartphones.

The data in table 5 above show that most of the dentist respondents in Jember have a good perception of dental-radiodiagnosis using smartphones, reaching 67.69%.

## 5. Perception of Dentists in Jember on dental-radiodiagnosis using smartphones based on the respondents' level of education and practice experience

Variable	Perception										Σ	
	Very good		Good		Fair		Poor		Very poor			
	n	%	n	%	n	%	n	%	n	%		
Education	General dentist	2	4.88	28	68.3	11	26.3	0	0	0	0	41
	Spesialist (Dental Radiology)	0	0	0	0	0	0	0	0	0	0	0
	Other specialists	0	0	4	80	1	20	0	0	0	0	5
	Master's/Doctor	2	10.5	12	63.2	5	26.3	0	0	0	0	19
<b>Total</b>											65	
Work experience	1 – 5 years	1	9.1	6	54.5	4	36.4	0	0	0	0	11
	6 – 10 years	0	0	8	100	0	0	0	0	0	0	8
	> 10 years	3	6.5	31	67.4	12	26.1	0	0	0	0	46
	<b>Total</b>											65

**Table 6.** Distribution of perceptions of dentists in Jember regarding interpretation/ radiodiagnosis using smartphones based on the respondents' level of education and practice experience.

The data in table 6 above show that based on the level of education, the perception of dentists in Jember on dental-radiodiagnosis using smartphones in all types of education is mostly good; 68.3% for general dentists, 80% for specialist dentists, and 63.2% for dentists with a master's or doctoral education. Likewise, based on length of work experience, for all lengths of work experience, the perception of dentists in Jember on dental-radiodiagnosis using smartphones at all levels of practice experience is mostly good; for practice experience of less than 5 years is 54.5%, 6-10 years 810%, and 10 years 67.4%.

## Discussion

Image is a way of conveying information in visual form that will be interpreted to let the intent and purpose be understood.<sup>11</sup> Medical images are images or cross-sectional images of certain body parts. The role of medical imaging in the medicine is quite important i.e. for supporting the diagnosis of patient diseases, treatment planning and disease monitoring. There are various imaging modalities that can be used for taking medical images, which can be used as needed. X-ray radiography is one of the means to produce medical images. X-ray radiographs

(radiographic images) are made by attenuated X-rays as they pass through the target object. Radiographic images are certainly different from other types of images, such as paintings and photographs.<sup>12</sup> Other medical facilities include magnetic resonance imaging (MRI), ultrasonography (USG), and computed tomography (CT), Positron Emission Tomography (PET), etc.<sup>13</sup>

There are 2 types of medical imaging technology using x-rays, namely analog and digital medical imaging. Analog medical imaging uses film to display the resulting image, whereas in digital imaging, the formed image is stored in a digital file.<sup>11</sup> Analog medical imaging or conventional radiography has long been used in medicine and dentistry, and this technology is still widely used even though digital radiography has existed and been developed. Digital radiography is currently not fully implemented due to several reasons such as human resources, supporting facilities and cost. Due to some of these obstacles, technology is developed to perform image processing from film media (analog images) into digital images, for example by using a scanner device or a camera on a cellphone. This medical image that has become a digital image can then be accessed and read/interpreted on a mobile phone or smartphone device.

Smartphones are multimedia cellular phones that have various functions such as text messages, cameras, music players, videos, games, email access, digital TV, search engines, personal information management, internet telephony services, etc. as well as personal digital assistant (PDA) functions such as calendar functions, agenda books, address books, calculators, and notes.<sup>6</sup> Currently, smartphone is a telecommunication tool that has been widely used in society and has reached various age groups and professions, including the dentist profession.

Among the applications in smartphones is an image processing application. Technological development in smartphone cameras provides camera pixel resolution ability to be higher and is able to compete with the resolution of DSLR cameras, so that they are able to provide results with better quality image without having to go through the editing process. The advantages of this smartphone are further supported by the advantages of other smartphones, namely

lightweight of portability of the device. Smartphones available today have specifications that are almost as sophisticated as desktop computers, for example in terms of resolution, screen color, processor speed, large storage, internet access, etc. With various devices, especially those related to image visualization, smartphones can actually be used properly for medical purposes, including interpretation and radiodiagnosis. In this study, the researchers first tried to explore the perceptions or responses or views of dentists in Jember regarding the interpretation and radiodiagnosis of dentistry using a smartphone. Perception is a person's view or feeling accompanied by a tendency to act on something.<sup>14</sup> Perception is influenced by one's knowledge or understanding and experience of it. Meanwhile, information disseminated through the media and peers will affect the level of perception positively.<sup>15</sup>

The results of the study obtained an average score of perception assessment for a number of statements submitted to respondents which were in "good" category. The results of this study indicated that the respondents have understood and confirmed that smartphones can be used or useful in dental-radiognosis cases/disorders in dental practice. From the results of this study, it can be assumed that most of the respondents (dentists) already have a good knowledge of what a smartphone is, especially in terms of image visualization and what dental-radiognosis is. Predictably, respondents already have experience or are accustomed to using smartphones on a daily basis for purposes similar to radiodiagnostics. This experience was then implemented by the respondents in activities related to dental practice, namely radiodiagnosis. This is because there are similarities in use of smartphones for visualization of images in general and images in the form of radiographs. The existing knowledge and experience will certainly affect the respondents' perception. However, this good perception is not completely linear with the use of smartphones where the level of use in interpretation and radiodiagnosis is still rare or only occasional, even though they already have a good perception about it.

The results of this study can also be compared with a study on tooth color selection using several smartphone cameras (Nikon DSLR D610, Xiaomi Mi4i and iPhone 6) whose results

show that it is still less accurate than conventional visual tooth color selection. However, it is said that with the development of smartphone camera technology and digital cameras, at a later time the smartphone will be suitable for use for tooth color selection.<sup>16</sup> Referring to the results of this study, the use of smartphones for interpretation and dental-radiodiagnosis, the results also have similarities, especially in visualizing images from radiograph so that it provides a good perception among dentists.

The results of the study that obtained respondents' perceptions in good categories may also mean that respondents agree to use smartphones in the process of interpretation and radiodiagnosing cases in dentistry. This is in accordance with the conclusion of a study which states that the respondents' approval in the use of social media networks can be interpreted that the respondents are willing to use social media for professional purposes.<sup>17</sup>

From the respondent general data, it is known that most of the respondents (61.54%) are general dentists. This means that there is a good perception of smartphone-based interpretation and radiodiagnosis produced in this study where the biggest contributors are general dentists. Researchers assume that formal education in this study is not related to respondents'

perceptions of the use of smartphones for radiodiagnostic purposes, but the most influential is the knowledge that many respondents get from social interactions or from information in various media. Perception is formed because of knowledge as a result of sensing whatever available in the environment. Sources of knowledge may come from the environment where someone is. Existing knowledge will lead to interpretations that will shape perceptions. In addition to knowledge, a person's perception is also influenced by education. Thus, formal education and knowledge actually contribute to the formation of one's perception.<sup>18</sup> For work experience, most of the respondents (73.85%) have work experience of more than 10 years. The relations between the length of practice experience and the level of perception of smartphone use in radiodiagnosis in dental practice certainly need further analysis.

The research data also show that there is a difference in perception between favorable statements where the average perception is good and unfavorable statements with fair perception categories. This is possibly due to the limitations of this study in controlling the responses of respondents. Respondents are estimated to have a lack of accuracy in answering unfavorable statements.

No	Smartphone Use	Perception					Score/Category
		SA	A	U	D	SD	
<i>Favorable Questions</i>							
1	The use of smartphone is very helpful in dental practice	16 (24.62)	44 (67.69)	5 (7.69)	0	0	271 Good
2	Smartphone-based radiodiagnosis helps dentists in radiodiagnosis process	8 (12.31)	46 (70.77)	11 (16.92)	0	0	257 Good
3	Smartphone-based interpretation and radiodiagnosis makes the radiodiagnosis process easier	17 (26.15)	38 (58.46)	10 (15.38)	0	0	267 Good
4	Smartphone-based interpretation and radiodiagnosis makes the radiodiagnostic process faster	20 (30.77)	36 (55.38)	8 (12.31)	1 (1.54)	0	268 Good
5	Smartphone-based interpretation and radiodiagnosis increases the accuracy of dental radiodiagnosis better	6 (9.23)	26 (40)	28 (43.08)	5 (7.69)	0	228 Good
6	Smartphone-based interpretation and radiodiagnosis are more advantageous to patients in dental care	14 (21.54)	40 (61.54)	10 (15.38)	1 (1.54)	0	262 Good
7	Smartphone-based interpretation and radiodiagnosis improve patient data storage (medical records), avoid damages and losses of patient data	10 (15.38)	32 (49.32)	11 (16.92)	9 (13.85)	3 (4.52)	232 Good
8	Smartphone-based interpretation and radiodiagnosis enhance the patient's favorable impression of the dentist's services	8 (12.31)	43 (66.15)	11 (16.92)	2 (3.08)	1 (1.54)	250 Good
<i>Unfavorable Questions</i>							
9	Smartphone-based interpretation and radiodiagnosis are technically more difficult than manual/conventional radiodiagnostic interpretations	0	22 (33.95)	23 (35.38)	19 (29.23)	1 (1.54)	194 Fair
10	Smartphone-based interpretation and radiodiagnosis have the opportunity for patient radiographic data to be manipulated because of the many features on smartphones	2 (3.08)	31 (47.69)	19 (29.23)	12 (18.46)	1 (1.54)	174 Fair
						240	Good

**Table 4.** Perceptions of dentists in Jember on dental-radiodiagnosis using smartphone.  
 Notes: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree.

## Conclusions

The perception of dentists in Jember Regency regarding the interpretation and radiodiagnosis of dental cases using smartphones is good.

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## Declaration of interest

We declare that there is no conflict of interest among the researchers and fund granter.

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