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Research Report

Knowledge and experience in using 2D and 3D diagnostic imaging among dentists in Surabaya

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ABSTRACT

Background: Radiography is essential in dentistry for diagnosis and treatment planning, with two-dimensional imaging such as panoramic and periapical radiographs being commonly used. The advancement to three-dimensional imaging, specifically Cone Beam Computed Tomography (CBCT), provides more detailed visualization but remains underutilized due to limited availability and knowledge among dentists in Indonesia. **Purpose:** This research is aimed to determine the knowledge and experience of using 2D and 3D diagnostic imaging among dentists in Surabaya. **Methods:** This research is using an observational descriptive study with a cross-sectional design consisting of 100 dentists who are domiciled in Surabaya and registered with PDGI in Surabaya. **Results:** The result showed that dentists' knowledge of 2D diagnostic imaging with a good category has a percentage of 18%, quite good category with 49% and poor category with 33%. Meanwhile, the dentists' knowledge of 3D diagnostic imaging with a good category has a percentage of 9%, quite good category with 36% and poor category with 55%. Around 88% of respondents have referred their patients for panoramic and periapical radiographs, while only about 22% of dentists have referred their patients for CBCT examinations. **Conclusion:** The knowledge of dentists regarding 2D diagnostic imaging is quite good, while the knowledge of dentists regarding 3D diagnostic imaging is low. The majority of dentists in Surabaya often refer their patients for panoramic and periapical radiographic examinations compared to referring them for CBCT examinations.

Keywords: Knowledge; dentist; radiography; diagnostic; imaging; medicine

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INTRODUCTION

Radiography in the field of dentistry is taking pictures with a certain amount of radiation to form an image that can be studied on a single film.[1] Radiographic examination can assist in making a diagnosis and determining a treatment plan. Radiographic examination can project areas that are not seen clinically, so that it can help the dentist to see the condition of the patient's oral cavity more clearly and in detail.[2,3] Radiography with good quality will affect the interpretation of what is seen in a radiographic result, where the more information that can be conveyed precisely, the goal in diagnosis can be achieved.[4]

Radiographic examination can produce two-dimensional and three-dimensional images. Two-dimensional radiography can visualize objects in the mesial-distal and apical-coronal planes.[5] Panoramic radiography and periapical radiography are radiographic techniques that are often used in dental practice to make a diagnosis and determine a treatment plan. Panoramic radiographs can display facial structures including the maxilla and mandible, as well as the temporomandibular joint in a single image.[6,7] While periapical radiographs can show an image that includes the crown, roots and supporting tissues of the teeth.[8] Periapical radiography is often used to detect periapical infection or inflammation, endodontic treatment and evaluate treatment results.[9,10]

Currently, radiographic examinations have developed from two-dimensional images to three-dimensional images commonly called Cone Beam Computerized Tomography (CBCT). CBCT can visualize an area completely, both axial, sagittal and coronal.[8] Radiographic examination with CBCT can be used for various specialist fields in dentistry. According to research by Yeung et al. (2020), CBCT is most

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commonly used for implant planning or evaluation (73.9%) and assessment of third molars (62.2%).[11] Optimization of the use of CBCT by dentists as the imaging modality of choice in supporting the diagnosis is still lacking. This may be due to the lack of availability of CBCT tools which are still limited in big cities such as Jakarta, Bandung and Surabaya as well as the lack of knowledge of Indonesian dentists regarding CBCT.[12]

Research on the use of dental radiography at RSGM Sam Ratulangi University, Manado, showed that only 10% of medical records were recorded using dental radiography, while 90% of medical records were not recorded using dental radiography. This shows that there are still many dentists who do not carry out radiographic examinations as a supporting examination in carrying out treatment.[13] Based on this, the authors are interested in knowing the knowledge and experience of dentists in Surabaya regarding the use of 2D and 3D diagnostic imaging for diagnostic purposes in dentistry.

MATERIALS AND METHODS

This research used a descriptive research with a cross-sectional design. This study describes the knowledge and experience of using 2D and 3D diagnostic imaging among dentists in Surabaya. This research was conducted from June 2022 to November 2022 at the Faculty of Dentistry, Airlangga University and online. The population in this study were all dentists who graduated from Indonesia and are domiciled in Surabaya.

The research sample is dentists in Surabaya who are still actively practicing with inclusion criteria, namely dentists practicing in Surabaya. The sampling method was carried out by means of a simple random method (random sampling).

Questionnaires that had been created using the Google form application were distributed via the WhatsApp social media platform to groups containing dentists spread throughout Surabaya. The questionnaire also included informed consent from the respondent. The questions used in the questionnaire function to find out the knowledge and experience of the respondents regarding the use of 2D and 3D diagnostic imaging for diagnostic purposes in dentistry. Respondent's answers were then evaluated with Microsoft Excel software to get the highest percentage of respondent's answer choices for each question.

RESULTS

Data on the distribution of respondents based on their gender showed that the majority of respondents were women, namely as much as 61%, and the majority of respondents from the age group of 21-30 years, as much as 48%. Respondents' answers regarding dentist knowledge of 2D diagnostic imaging can be seen in Table 1. A total of 24 out of 100 respondents answered very knowledgeable and 67 respondents answered they knew about 2D diagnostic imaging in dentistry. The next question related to respondents' knowledge of the receptors used for periapical imaging, around 15% of respondents knew the receptors used for periapical imaging. Furthermore, 50% of respondents answered correctly regarding knowledge related to film sizes used for small children, namely size 0. Then, 49 respondents answered correctly regarding knowledge related to film sizes used for adults, namely size 2. However, on the question regarding occlusal film sizes or films used used to indicate the area of the upper or lower temples, only 35% of respondents answered correctly, that is, the size of the occlusal film was size 4. Of all the respondents, around 39% of respondents still did not know about the collimator used in dentistry. A total of 48% of respondents know the radiation dose adjustment when carrying out radiographic examinations. On questions related to the techniques for taking periapical radiographs, many respondents already very knowledgeable (52%) and really knowledgeable (7%) about the techniques for taking periapical radiographs.

Respondents' answers regarding dentist knowledge of 3D diagnostic imaging can be seen in Table 2. As many as 65% of respondents know 3D diagnostic imaging in dentistry. However, in the next question regarding the Field of View (FOV) used for CBCT, only 12% of respondents knew the FOV used for CBCT. The last question is respondents' knowledge regarding the low-dose protocol on CBCT devices, around 32% of respondents still do not know the low-dose protocol on CBCT devices.

The distribution of respondents' answers regarding the experience of using 2D diagnostic imaging among dentists can be seen in Table 3. A total of 88 respondents answered that they had referred their patients for panoramic radiographic examinations. Of the 88 respondents who had referred their patients for panoramic radiographic examinations, 80 of them answered that they had referred their patients at least 1-10 times in 1 month, followed by 7 respondents who answered that they had referred their patients at least 11-20 times in 1 month, while the remaining 1 respondent answered have referred their patients at least 21-30 times in 1 month for panoramic radiographic examinations. Respondents' confidence in interpreting the panoramic results certainly varied, 6 respondents felt very confident and 77 respondents felt confident in interpreting the panoramic results. However, there were 15 respondents who were still uncertain and 2 respondents who were not confident in interpreting the panoramic results.

Of the total respondents, 88 respondents answered that they had referred their patients to perform periapical radiographic examinations. Of the 88 respondents who had referred their patients for periapical radiographic examinations, 77 of them answered that they had referred their patients at least 1-10 times in 1 month, followed by 8 others who answered that they had referred their patients at least 11-20 times in 1 month, and 2 others answered that they had referred their patients at least 21-30 times in 1 month while the remaining 1 respondent answered that they

had referred their patients at least > 30 times in 1 month to perform periapical radiographic examinations. Regarding confidence in interpreting periapical results, 84 respondents felt confident and 8 respondents felt very confident in interpreting periapical results.

The distribution of respondents' answers regarding the experience of using 3D diagnostic imaging (Cone Beam Computerized Tomography/CBCT) among dentists can be seen in Table 4. Of the total respondents, only 22% of respondents had ever referred their patients for a CBCT examination, while the other 78% had not. ever referred a patient for a CBCT examination. The 22 respondents who had referred their patients for a CBCT examination answered at least 1-10 times in 1 month referring their patients for a CBCT examination. The last question item, which is about confidence in interpreting the CBCT results, respondents who are uncertain (36%), disagree (21%) and strongly disagree (22%) are more than the number of respondents who agree (18%) and strongly agree or (3%) about it.

Table 1. Distribution of respondents' answers regarding dentist knowledge of 2D diagnostic imaging

Question	n (%)
Knowledge of 2D diagnostic imaging in dentistry	
Very knowledgeable about	24 (24%)
Knowledgeable about	67 (67%)
Uncertain	6 (6%)
Unknowledgeable about	3 (3%)
Very unknowledgeable about	0
Knowledge of receptors used for periapical imaging	
Very knowledgeable about	2 (2%)
Knowledgeable about	15 (15%)
Uncertain	31 (31%)
Unknowledgeable about	31 (31%)
Very unknowledgeable about	21 (21%)
Knowledge of the size of the film used for children	
Size 0	50 (50%)
Size 1	33 (33%)
Size 2	8 (8%)
Size 3	3 (3%)
Size 4	6 (6%)
Knowledge of the size of the film used for adults	
Size 0	3 (3%)
Size 1	13 (13%)
Size 2	49 (49%)
Size 3	21 (21%)
Size 4	15 (15%)
Knowledge of the size of the occlusal film or films used to show the maxillary or mandibular area	
Size 0	7 (7%)
Size 1	13 (13%)
Size 2	25 (25%)
Size 3	16 (16%)
Size 4	39 (39%)
Knowledge of collimators used in dentistry	
Very knowledgeable about	2 (2%)
Knowledgeable about	7 (7%)
Uncertain	17 (17%)
Unknowledgeable about	39 (39%)
Very unknowledgeable about	35 (35%)
Knowing that it is necessary to adjust the radiation dose when carrying out radiographic examinations	
Very knowledgeable about	11 (11%)
Knowledgeable about	48 (48%)
Uncertain	24 (24%)
Unknowledgeable about	11 (11%)
Very unknowledgeable about	6 (6%)
Knowledge of several techniques for taking periapical radiographs	
Very knowledgeable about	7 (7%)
Knowledgeable about	52 (52%)
Uncertain	23 (23%)
Unknowledgeable about	12 (12%)
Very unknowledgeable about	6 (6%)

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Table 2. Distribution of respondents' answers regarding dentist knowledge of 3D diagnostic imaging

Question	n (%)
Knowledge of 3D diagnostic imaging in dentistry	
Very knowledgeable about	6 (6%)
Knowledgeable about	65 (65%)
Uncertain	16 (16%)
Unknowledgeable about	7 (7%)
Very unknowledgeable about	6 (6%)
Knowledge of the Field of View (FOV) used for CBCT	
Very knowledgeable about	1 (1%)
Knowledgeable about	12 (12%)
Uncertain	24 (24%)
Unknowledgeable about	26 (26%)
Very unknowledgeable about	37 (37%)
Knowledge of low-dose protocol on CBCT devices	
Very knowledgeable about	1 (1%)
Knowledgeable about	15 (15%)
Uncertain	29 (29%)
Unknowledgeable about	23 (23%)
Very unknowledgeable about	32 (32%)

Table 3. Distribution of respondents' answers regarding the experience of using 2D diagnostic imaging

Question	n (%)
Experience referring patients to perform panoramic radiographic examinations	
Had ever	88 (88%)
Had never	12 (12%)
Frequency of referring patients for panoramic radiographic examinations within 1 month	
0	12 (12%)
1-10	80 (80%)
11-20	7 (7%)
21-30	1 (1%)
>30	0
Confidence in interpreting panoramic images	
Very confident	6 (6%)
Confident	77 (77%)
Uncertain	15 (15%)
Unconfident	2 (2%)
Very unconfident	0
Experience referring patients to perform periapical radiographic examinations	
Had ever	88 (88%)
Had never	12 (12%)
Frequency of referring patients for periapical radiographic examination within 1 month	
0	12 (12%)
1-10	77 (77%)
11-20	8 (8%)
21-30	2 (2%)
>30	1 (1%)
Confidence in interpreting periapical images	
Very confident	8 (8%)
Confident	84 (84%)
Uncertain	6 (6%)
Unconfident	2 (2%)
Very unconfident	0

Table 4. Distribution of respondents' answers regarding the experience of using 3D diagnostic imaging

Question	n (%)
Experience referring patients to perform Cone Beam Computerized Tomography (CBCT) examinations	
Had ever	22 (22%)
Had never	78 (78%)
Frequency of referring patients for CBCT examination within 1 month	
0	78 (78%)
1-10	22 (22%)
11-20	0
21-30	0
>30	0
Confidence in interpreting CBCT images	
Very confident	3 (3%)
Confident	18 (18%)
Uncertain	36 (36%)
Unconfident	21 (21%)
Very unconfident	22 (22%)

DISCUSSION

From the data that has been collected, it is found that many dentists (67%) know about 2D diagnostic imaging in the field of dentistry. However, fewer dentists knew about 3D diagnostic imaging in the field of dentistry compared to dentists who knew about 2D diagnostic imaging, where 6% of dentists knew very well and 65% knew about 3D diagnostic imaging in dentistry. This could be because CBCT is not included in the Indonesian Dentist Competency Standards (SKDGI) so that material on CBCT is not included in the curriculum and is not widely explained in Dentist Education Programs in Indonesia. In addition, dentists' knowledge of CBCT is generally obtained through independent study outside of formal education or from experienced colleagues.[12]

Based on the answers given by respondents through distributed questionnaires, it was found that the knowledge level of 2D diagnostic imaging among dentists in Surabaya was in the quite good category. This can be seen from the respondents' answers regarding questions about knowledge of periapical radiography which consists of several questions covering film receptors, collimators, radiation dose adjustments, and periapical imaging techniques. In the question item regarding receptors used for periapical imaging, there were still many respondents who answered uncertain (31%) and did not know (31%). This is due to the term periapical receptor which may be quite foreign to the majority of dentists, where in White and Pharoah (2014) the term used is intraoral film and the majority of dentists still use conventional radiography where conventional radiography components use conventional films.[8,14] Of all the answers, 50% of respondents know the size of the film used for children. About 49% of respondents

answered correctly regarding the film size used for adults. Meanwhile, only about 35% of dentists know about the size of the occlusal film or the film used to show the maxilla or mandibular area. In this study, there were still many dentists who did not know about collimators used in dentistry, this could be since the majority of dentists only referred their patients for radiographic examinations and lacked experience in performing radiography. Furthermore, in the question item regarding dose adjustment, 48% of dentists knew that it was necessary to adjust the radiation dose when carrying out radiographic examinations. In this study, the majority of dentists answered that radiation dose adjustments could be made according to the location of the teeth and the patient's body size. In the question item regarding the knowledge of dentists regarding periapical radiography taking techniques, the majority of dentists (52%) already knew the techniques for taking periapical radiographs. The majority of dentists mention that the parallel technique and bisecting technique are techniques in taking periapical radiographs. Budiman and Riyanto (2013) state that factors that can influence knowledge include education, information, and experience.[15]

The results of research on knowledge of 3D diagnostic imaging among dentists in Surabaya are in the poor category. This can be seen in the distribution of respondents' answers where only 12% of dentists know about FOV, and around 15% of dentists know about the low-dose protocol on CBCT devices. This could be because there are still many dentists who have never done CBCT.

Continuing to question the experience of using 2D and 3D diagnostic imaging, the results of the study show that the majority of dentists in Surabaya often refer their patients for panoramic and periapical radiographic examinations compared to referring them for CBCT examinations. This can be seen in the distribution of answers where 88% of dentists have referred their patients for panoramic or periapical radiographic examinations, whereas only about 22% of dentists have referred their patients for CBCT examinations. This is likely due to the limited availability of CBCT devices.[12] In this study, 77% of dentists were confident in interpreting panoramic results and about 84% of dental dentists were confident in interpreting periapical results. However, only about 18% of dentists are confident in interpreting CBCT results. The high level of confidence of respondents in interpreting the results of panoramic and periapical images is probably influenced by differences in age and length of practice as clinicians.[11]

In this study, the majority of respondents referred their patients for a panoramic radiographic examination to determine the location of the third molars, to see abnormalities of the teeth and TMJ and during the growth and development period (mixed dentition). This is in accordance with the theory which states that the indication for panoramic radiography is to detect dental caries, see whether or not there are lesions, jaw fractures, tumors, and tooth growth during the mixed dentition.[8,16] Meanwhile, cases such as infection/inflammation of apical teeth, root canal treatment, assessment of periodontal conditions and assessment of root morphology before extraction were the most frequently chosen indications for respondents to refer their patients for periapical radiographic examinations. The most common reason dentists refer their patients for CBCT examinations is for implant planning, maxillofacial surgery (such as trauma and orthognathic surgery) and jaw pathology such as cysts.

The knowledge of dentists in Surabaya regarding 2D diagnostic imaging is in the quite good category, while knowledge regarding 3D diagnostic imaging is still in the poor category. The majority of dentists in Surabaya often refer their patients for panoramic and periapical radiographic examinations compared to referring them for CBCT examinations, this is because there have been no cases requiring patients to perform CBCT examinations and the limited number of CBCT devices in their workplaces.

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