

# Common Errors on Conventional and Digital Panoramic Radiographs

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Received: April 23, 2014; Revised: May 14, 2014; Accepted: May 20, 2014

**Background:** Identification of common technical errors during preparation of panoramic radiographs, how affect the quality and interpretation of the radiographs and the techniques used to deal with such errors, might help prevent unnecessary radiation to patients and save their time and money.

**Objectives:** The current study aimed to identify common errors in the panoramic radiographs taken by post-graduate students in the Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Hamadan University of Medical Sciences.

**Patients and Methods:** A total of 220 conventional and digital panoramic radiographs of patients who were referred to the Department of Radiology were selected for the current study. All the radiographs had been taken by the post-graduate radiology students. The radiographs were evaluated by two oral and maxillofacial radiologists, under standard visualization conditions, to identify technical errors.

**Results:** From the evaluated radiographs, 193 (87.7%) had one or more technical errors. The most common error was twisting of the head to one side (31.8%), followed by superimposition of the palatoglossus air space on the apices of maxillary incisors (30.9%).

**Conclusions:** The errors identified in the present study might be attributed to a lack of proper verbal communication between the patients and the post-graduate students, which necessitates continuous education of operators who take panoramic radiographs.

**Keywords:** Radiography, Panoramic; Radiography, Dental, Digital; Radiation Equipment and Supplies; Radiography

## 1. Background

Panoramic radiography is a simple extra oral radiographic technique which allows visualization of all the maxillary and mandibular areas on one radiographic film, which is a valuable adjunct to routine diagnostic procedures (1). Panoramic radiography is popular diagnostic tool and is used alone or along with other radiographic techniques (2). At present, it is widely used in dentistry as a useful tool for the diagnosis and treatment planning (3). Panoramic radiographs are clinically useful to diagnose conditions that require a wide coverage of the jaws, including traumas, the position of third molars, extensive disease entities, identification of suspected large lesions, tooth development (especially in the mixed dentition period), residual teeth or roots (in edentulous patients), and congenital/developmental anomalies. Such cases do not require the high resolution and the great details observed on intraoral images (1).

In cases that the diagnostic quality is not satisfactory, the value of the radiographic images decreases and they should be repeated, resulting in increased exposure to radiation, more costs, and waste of time (4). Such compromised quality is not the result of inherent limitations of radiographic equipment; rather, they usually result from errors committed by the operators during patient adjustment. Therefore, knowledge about common errors during preparation for panoramic radiographs might be

effective in preventing unnecessary exposure of the patients to radiation, wasting their time, imposing extra costs to them, and finally resulting in high quality images (5, 6). In a study by Rushton, the most common technical errors were the patients' anteroposterior position, and low radiographic contrast and density (7). In another study, 35% of the images were free of errors and in 20% of them the patients' heads were in a more anterior position than the standard. In 15.5% of the images the patients had not placed their tongues on the palate. In general, the least frequent error was related to patient movement (8). In a study by Al-Faleh the most common positional error was superimposition of the palatoglossus air space on the roots of maxillary incisors (81.8%), followed by a half slumped position of the patients (17.2%) (9). In a study by Brezden, there were position and film processing errors in 467, and 441 radiographs, In that study, the severity of errors which affected diagnostic quality determination was more important than their number (10). In a study by Glass et al., the most common errors in panoramic radiographs of 75 edentulous patients were evaluated; in 67 radiographs (89.3%) there were one or more errors regarding the correct positioning of the patients (11).

## 2. Objectives

Considering the high number of patients who were referred to the Department of Oral and Maxillofacial

Radiology, Hamadan University of Medical Sciences, and the high possibility of errors during radiographic procedures, and since no such data were available in Hamadan University of Medical Sciences, the current study aimed to evaluate the type of errors on conventional and digital panoramic radiographs taken in this department from 2012 to 2013 academic year.

### 3. Patients and Methods

In the current study, the panoramic radiographs of 220 patients (110 conventional and 110 digital) who were referred to the Department of Oral and Maxillofacial Radiology, Hamadan University of Medical Sciences, were evaluated. All the panoramic radiographs had been taken by post-graduate students of oral and maxillofacial radiology, using Cranex Tom panoramic machine (Soredex, Helsinki, Finland) based on manufacturer's instructions. The exposure parameters for kVp and mAs were determined based on the body size, gender, age, guidelines inscribed on the x-ray machine, and finally the experience of the operator. Conventional radiographs were prepared with the use of panoramic AGFA films (15 × 30 cm) and rare element intensifying screens and processed by HOPS (HOPE Co., USA) automatic processing unit under similar temperature and time condition. Digital radiographs were prepared by a SPS digital sensor (Soredex, Helsinki, Finland) and scanned by DIGORA PCT scanner (Soredex, Helsinki, Finland) and were recorded by Dogora for Windows (DfW) software. Modifications were made in density and contrast to acquire an ideal quality, as far as possible, based on the idea of the trained post graduate students. Finally, a hard copy of the final version was prepared from the image available on the monitor.

Children under three years old and patients who could not stand still due to their physical or mental conditions were excluded from the study. The digital and panoramic radiographs were visualized on a viewer box with proper

illumination; the margins of the radiographs were covered with opaque paper and light reached the eyes of the viewer through the radiograph. Visualization procedures were carried out in a dimly lit room by an oral and maxillofacial radiologist for possible technical errors. In cases of uncertainty about the presence of errors, a second radiologist was consulted and after collecting the opinions and reaching a consensus, the errors in question were registered. The existing recorded errors occurred regarding the patient positioning, patient movement, residual metallic objects, density, and other common errors in the relevant questionnaire. Data were analyzed by SPSS software version 19, using relevant statistical tests.

### 4. Results

In the current study, out of 220 evaluated panoramic radiographs, 178 (80.9%) had at least one technical error; however, the radiographs did not need to be repeated considering the type of error and lack of significant effect on the diagnostic quality. In contrast, 15 radiographs (6.8%) needed to be repeated due to the severity or multiplicity of errors, resulting in compromised diagnostic quality. In addition, 27 radiographs (12.3%) had no errors (Figure 1). The total number of errors was 387 in 220 radiographs, out of which 173 errors were observed in digital and 209 in conventional radiographs. The errors were less numerous in digital radiographs compared to the conventional ones, but the difference was not statistically significant (Table 1).

In addition, the results of the current study showed that patient positioning errors were very common; in this context, errors regarding twisting of the head, positioning of the chin higher or lower than normal, positioning of the head more posteriorly, tilting of the head, positioning of the chin more anteriorly, and patient slumping were the most common errors in descending order (Table 2). Other errors are presented in Table 3.

**Table 1.** Comparison of Technical Errors Between the Digital and Conventional Panoramic Radiographs <sup>a</sup>

Group	Status of the Radiograph			P value
	With Errors	Without Errors	Requiring Repetition	
Conventional (n = 110 )	86 (72.8)	14 (12.7)	10 (9.1)	0.41
Digital (n = 110 )	92 (83.6)	13 (11.8)	5 (4.5)	
Total (n = 220 )	178 (80.9)	27 (12.3)	15 (6.8)	

<sup>a</sup>Data are presented as No.(%).

**Table 2.** Comparison of the Errors Regarding Positioning of Patients in the X-Ray Unit Between Conventional and Digital Panoramic Radiographs <sup>a</sup>

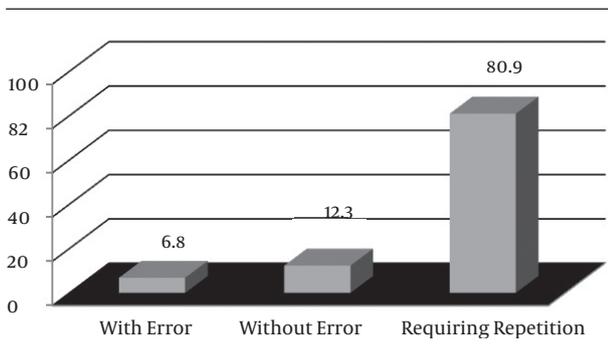
Group	Different Patient Positioning Errors						
	Chin Positioned Posteriorly	Chin Positioned Anteriorly	Chin Positioned Superiorly	Chin Positioned Inferiorly	Twisting of the Head	Tilting of the Head	Patient Slumping
Conventional (n = 110)	15 (13.6)	10 (9.1)	16 (14.5)	23 (20.9)	36 (32.7)	14 (12.7)	8 (7.3)
Digital (n = 110)	18 (16.4)	13 (11.8)	39 (35.5)	12 (10.9)	34 (30.9)	11 (10)	7 (6.4)
Total (n = 220)	33 (15)	23 (10.5)	55 (25)	35 (15.)	70 (31.8)	25 (11.4)	15 (6.8)

<sup>a</sup>Data are presented as No.(%).

**Table 3.** Other Errors in the Panoramic Radiographs Separately for Each Type of Radiograph <sup>a</sup>

Group	Error Type					
	Metallic Objects	Exposure to Visible Light in the Darkroom	Patient Movement No.	Film Contamination With the Fixative	Noise	Static Electricity Fog Film Crimping
Conventional (n = 110)	6 (5.5)	3 (2.7)	2 (1.8)	10 (9.1)	0	0
Digital (n = 110)	0	0	0	0	4 (3.6)	0
Total (n = 220)	6 (5.5)	3 (2.7)	2 (1.8)	10 (9.1)	4 (3.6)	0

<sup>a</sup> Data are presented as No.(%).



**Figure 1.** Comparison of Frequencies of Overall Common Errors in the Evaluated Radiographs

### 5. Discussion

In routine dental procedures, panoramic radiographic technique is of great significance because it allows proper evaluation of large anatomic areas and due to the possibility to evaluate jaw fractures, tooth development, and maxillary sinus problems (1). Contrary to these advantages, this technique has one clear drawback; if the patient is not correctly positioned in the x-ray unit, diagnostic data might be compromised or lost (6). Therefore, the present study evaluated different types of errors occurring during preparation for conventional and digital panoramic radiographs. In the present study, some errors were absent or minimal due to the digital nature of radiographs, including errors of darkroom, lack of patients' particulars, and errors regarding the exposure variables of kVp and mAs, which are confined to analog radiographic techniques and manual processing procedures; therefore, evaluations and comparisons of such errors are relevant only in conventional panoramic radiographs. On the other hand, errors of patient positioning apply to both conventional and digital techniques. The results of the current study showed that patient positioning errors were very common in conventional and digital panoramic radiographs, and head twisting (31.8%), the chin higher than normal (25%), the chin lower than normal (15.9%), the head posterior than normal (15%), tilting of the head (11.4%), the chin anterior than normal (10.5%), and patient slumping (6.8%) were common in descending order (Table 2).

In a study by Kaviani, head twisting and hypo and hyper extension of the chin were the most common errors in patient positioning, which are consistent with the results

of the present study. Generally, 75% of the radiographs evaluated in the present study had the patient positioning errors, which is consistent with the results of studies carried out by Kaviani et al. and Glass et al. in which 78% and 89% of the radiographs, respectively, had patient positioning errors (4, 11). Of all these errors, patient slumping was a more frequent problem among the elderly and since these patients comprised a small proportion of the patients; their prevalence was much lower compared to the other errors. Since positioning and guiding the patients during radiography is the responsibility of the operator (in these cases post graduate students), the incidence of such errors was directly related to the expertise and sense of responsibility of the operators. In a study by Akarslan, it was reported that the superimposition of the palatoglossus air space on the apices of maxillary incisors was the most prevalent error, which is due to not placing the tongue on the palate during radiography (12). In the current study, the palatoglossus air space was visualized in 30.9% of the radiographs. Therefore, it was one of the most common errors on the radiographs. The occurrence of this error depends on instructing the patients correctly by the operator and patient compliance to follow the instructions; it is the operators' responsibility to instruct the patients to place their tongues on the palate during radiography. However, in some patients this air space is visualized despite instructions given to the patients, especially in children and the elderly due to their inability to carry out complex movements with their tongue; such visualization compromises image quality, especially in the areas of maxillary incisors. In the study by Kaviani, darkroom errors were the second most common errors in radiographs after patient positioning errors (4). Among the darkroom errors, insufficient fixation, high density, and low contrast were more common than the other errors. However, since conventional panoramic radiographs are processed automatically in Faculty of Dentistry, Hamadan University of Medical Sciences, the prevalence of these errors was much lower compared to previous studies and only errors such as finger spots (in eight conventional radiographs) and contamination with fixing solution (only in two radiographs) were observed. It is highly probable that mistakes during adjustment of mAs and KVP by the operator were the etiologic factor for errors such as high or low density and unfavorable contrast in the current study, because such errors are minimal due to similar conditions of the time and

standard temperature of processing solutions in automatic processors.

Overexposure and underexposure were observed in 10% and 2.7% of conventional radiographs, respectively. It is obvious that such errors are very rare in digital panoramic radiographs due to the wide radiation range of digital sensors and no need for chemical processing procedures. In this context, in the present study only four digital radiographs had image noise because of underexposure. Incomplete patient particulars were found in 16 (14.5%) of conventional panoramic radiographs. No data were found about this point in the previous studies. Residual metallic objects and denture during radiography were observed in 5.5% of the radiographs. The prevalence of this error was 3.2% in Kaviani's study. Another error was the exposure of the film to visible light before developing the film, found in three radiographs. Since these two errors usually result in repetition of the radiographic technique, their occurrence is very important and their low prevalence is particularly significant. In three conventional radiographs, the English characters of (L) and (R), indicating left and right sides had been registered in reverse because the cassette had been placed in reverse position. In all the evaluated radiographs, patient movement had caused error only in two radiographs (Table 3).

Totally, 80.9% (178) of radiographs had at least one of the errors under study and only 12.3% (27) of the radiographs were free of errors, and even the errors on digital and conventional radiographs were completely different. Repetition of the technique occurred in 4.5% and 9.1% of digital and conventional radiographic techniques, respectively (Table 1). This two fold difference might be attributed to the very low incidence of important errors such as the exposure of film to visible light before film developing and very high or low density, which are almost entirely eliminated due to the nature of the digital system. However, the results of the present study showed that the number of conventional and digital free of error radiographs were almost the same (14 and 13 radiographs, respectively) (Table 1).

Generally, the prevalence of technical errors was very high in conventional and digital panoramic radiographs and out of the 220 evaluated radiographs only 27 radiographs were free of technical errors. In addition, conventional radiographic techniques were repeated more frequently compared to the digital techniques. Considering

the high prevalence of errors, it is necessary to provide more applied instructions and increase the attention of operators during the positioning of the patients.

## Acknowledgements

The authors would like to thank the Dental Research Center and Research Vice Chancellor of Hamadan University of Medical Sciences, for supporting this study.

## Authors' Contributions

Fatemeh Salemi developed the original idea and the protocol, abstracted and analyzed data, wrote the manuscript, and is guarantor. Abbas Shokri and Sepideh Falah contributed to the development of the protocol, abstracted data, and prepared the manuscript.

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