

Comparison between Two Digital Panoramic Radiography Techniques for Proximal Caries Detection

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Abstract

Introduction: Although proximal dental caries are very common, clinical examinations cannot detect them all. Panoramic radiography has been widely used in dentistry for both diagnosis and screening. This study aimed to investigate and compare the efficacy of two digital panoramic radiography techniques in the diagnosis of proximal caries. **Methods:** A total number of 60 patients referred to a dental radiology center, all had complete dental system and bitewing radiographies, were included. The patients were randomly divided into two groups of 30 patients. For the first and second groups, CR and DR images were obtained respectively. Images were obtained from the distal of the third tooth to the distal of the eighth. Bitewing images were compared with CR and DR images regarding the detection of caries. Kappa index and chi-squared statistics were employed to analyze the results. **Results:** There was a high agreement rate between bitewing images and CR (Kappa=0.775) and DR (Kappa=0.762) images in detecting caries. Also no significant difference was shown between CR and DR techniques in the detection of caries (0.543). However, DR and CR images are not efficient enough to be prescribed as the sole imaging technique to detect proximal caries. **Conclusion:** DR and CR techniques could be good imaging techniques for the detection of dental caries as a companion to clinical examinations.

Key Words: Dental caries, digital radiography, panoramic radiography, proximal caries.

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Introduction

Dental caries especially the proximal caries are very common. Accurate detection of such conditions is highly dependent on appropriate radiographies as well as detailed clinical investigation. However detecting dental caries is still a challenge requiring radiographic evaluations with high accuracy. Bitewing radiography was introduced as an established and useful radiologic technique for the diagnosis of caries in patients (1). However, the benefit of imaging techniques such as bitewing radiography over visual examination for assessing caries is still unclear (2). Panoramic radiography has been widely used in the detection and screening process of dental pathologies (3,4). Moreover, recent fundamental improvements in digital radiography made it more accessible for radiologists to apply. Digital radiography has advantages such as easier achieving, faster data transfer, higher image analysis ability, and exclusion of the dark room process for the acquisition of the radiographic images (4,5).

Digital panoramic radiography produces images with quality similar to conventional panoramic images (6). Digital radiography could be performed by two different techniques including Photo Stimulate Phosphor (PSP) or Computed Radiography (CR) and Charged Coupled Device (CCD) or Digital Radiography (DR) (7).

The majority of the studies previously performed to investigate the efficacy of imaging techniques for caries diagnosis were largely in vitro and mainly performed on extracted permanent teeth (2,8,9). Therefore, a major need for in vivo studies is felt to clarify the exact efficacy of various imaging modalities in the detection of caries. This study is designed and conducted to investigate the diagnostic efficacy of the two digital panoramic radiography techniques in the detection of proximal dental caries in patients.

Materials and Methods

In this study, 60 patients referred to a dental radiology center in Mashhad, Northeast Iran were included. All patients had complete tooth system. Bitewing and digital panoramic images (CR or DR) were obtained for all patients to detect caries. A total 2640 proximal sides from the distal of the canine to the distal of the wisdom tooth were investigated.

This study was approved by the ethical committee of Mashhad University of Medical Sciences regarding ethical and methodological issues. A written informed consent was obtained from each individual after the aims and procedures were fully introduced to them and their questions were answered.

For each patient, four posterior bitewing radiographs were obtained using Planmeca Intraoral (Planmeca, Helsinki, Finland) and AGFA film (E speed) with 60-64 kVp, 8 mA, and 0.25 sec adjustments. The images were developed using Air Technique Processor (USA) after 8 min in processing materials (TETENAL, Germany). All patients were randomly categorized into two groups of 30 patients. Digital panoramic images were obtained for patients using DR and CR techniques. For the first group of the patients DR images were obtained using Planmeca Promax (Planmeca, Helsinki, Finland) and images were stored in a desktop computer for further analysis. For the second group CR images were obtained using Planmeca XC (Planmeca, Helsinki, Finland) and the images were digitalized using Konica CR 110 (Japan) and stored in a desktop computer for further analysis.

Bitewing radiographies and hard copies related to the CR and DR images obtained from a printer (Konica-Japan) were evaluated by a negatoscope (DG-Dent) by an oral radiologist for the detection of caries and the results were registered for each individual. The panoramic images were evaluated after two weeks. The frequency and location of caries were registered for each individual. Data were registered using SPSS V.18.0. Kappa index was employed to compare bitewing images as the gold standard with CR and DR images and chi-squared and Fisher's exact tests were employed to compare CR and DR results. Related tables

were produced to discuss the results. P-values < 0.05 were considered as statistically significant.

Results

A total number of 60 patients with 2640 proximal sides from the distal of the third tooth to the distal of the eighth tooth were investigated. The comparison between bitewing and CR images in the first group of the patients (n=30) revealed 211 carious sides in bitewing images while CR images showed 155 carious sides (73.3%) correctly and could not detect 56 carious sides (26.7%). Also from the 1109 normal sides reported in bitewing images, CR images revealed 18 (1.6%) carious sides and 1091 (98.4%) normal (Table 1). Kappa index analysis showed high agreement between bitewing and CR techniques in the detection of caries (Kappa=0.775). The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CR images in the detection of proximal dental caries was 73%, 98%, 89%, and 95%, respectively. Similarly in the second group of the patients (n=30) bitewing and DR images were compared. From the 195 carious sides reported in bitewing images, DR images revealed 138 carious sides (71%) and 75 sides (29%) were reported as normal. Also from the 1125 normal sides reported in bitewing images, DR images revealed 9 carious sides (0.8%) and 1116 normal sides (99.2%) (Table 2). Kappa index showed high agreement between bitewing and DR images in the detection of proximal dental caries (Kappa=0.782). The sensitivity, specificity, PPV, and NPV of DR technique in the detection of proximal dental caries was 71%, 99%, 93%, and 95%, respectively.

The comparison between CR and DR images showed 5.6% and 5% error rate in the detection of caries respectively while they could correctly diagnose 94.4% and 95% of caries respectively. No statistically significant difference was present between both techniques in the detection of proximal dental caries (P=0.543) (Table 3).

In another measurement the efficacy of DR and CR techniques to detect proximal caries was separately evaluated for canines, first and second premolars, and also for first, second and third molars (Table 4). The results of this measurement showed a lower agreement rate between the results of CR and DR images with bitewing images in diagnosing caries in canines, first and second premolars (Kappa=0.707 for CR and Kappa=0.651 for DR). However, both CR and DR images showed high agreement with bitewing images in the detection of caries for first, second and third molars (Table 4). Moreover, no significant difference between DR and CR images were present for the detection of caries in these 6 teeth (canine to third molar) (P>0.05).

Table 1. Comparison between bitewing and CR* images in the detection of proximal caries

		Caries in Bitewing images				Kappa
		Positive		Negative		
		Number	Percent	Number	Percent	
Caries in CR images	Positive	155	73.3	18	1.6	0.775
	Negative	56	26.7	1091	98.4	
Total		211	100	1109	100	

*Computed Radiography

Table 2. Comparison between bitewing and DR* images in the detection of proximal caries

		Caries in Bitewing images				Kappa
		Positive		Negative		
		Number	Percent	Number	Percent	
Caries in DR images	Positive	138	71	9	0.8	0.782
	Negative	57	29	1116	99.2	
Total		195	100	1125	100	

*Digital Radiography

Table 3. Comparison between CR* and DR** images regarding the detection of proximal caries

	CR		DR		P-value
	Number	Percent	Number	Percent	
Correct	1246	94.4	1254	95	0.543
False	74	5.6	66	5	
Total	1320	100	1320	100	

* Computed Radiography, ** Digital Radiography

Table 4. Comparison between bitewing images with CR* and DR** images in the detection of proximal caries of canines, first and second premolars and first, second and third molars

			Bitewing				Kappa
			Positive		Negative		
			Number	Percent	Number	Percent	
Canines, first and second premolars	CR	Positive	66	65.8	10	1.9	0.707
		Negative	34	34.2	490	98.1	
		Total	100	100	500	100	
	DR	Positive	41	51.6	0	0	0.651
		Negative	37	48.4	522	100	
		Total	78	100	522	100	
First, second and third molars	CR	Positive	88	78.6	8	1.3	0.820
		Negative	24	21.4	600	98.7	
		Total	112	100	608	100	
	DR	Positive	93	81.6	8	1.3	0.842
		Negative	21	18.4	598	98.7	
		Total	114	100	606	100	

* Computed Radiography, ** Digital Radiography

Discussion

Proximal dental caries are very common in patients and early detection and treatment could greatly assist such patients. Accurate and early detection of proximal caries require radiographic evaluations. Panoramic radiography has been introduced as a useful imaging technique in dentistry for the diagnosis and screening of patients with dental problems. Some advantages of this technique include relatively lower dosage of radiation, cost effectiveness, and production of a single image for both dental arches. However, panoramic radiography also has some limitations including lower resolution comparing with periodontal images, lower accuracy in showing details, and unequal magnification (10).

With the introduction of digital panoramic radiography in the recent years this technique has regained its previous attention and become more prevalent in dental imaging procedures. In the present study we compared two common digital panoramic imaging techniques in the detection of proximal caries.

The results of our study showed that both CR and DR images had high agreement rates with bitewing images than the standard imaging procedure in the detection of proximal caries. Besides, our results revealed no significant difference between CR and DR images in the diagnosis of caries. However, the results also indicated that DR and CR images were not 100% efficient in the detection of proximal caries.

Choi (11) compared clinical examination and panoramic radiography in the diagnosis of dental caries and reported higher accuracy of panoramic images. Therefore, the combination of clinical examination and panoramic images could be very useful in the detection of caries.

The results of the present study also supported this hypothesis and suggested digital panoramic images as good tools for the diagnosis of caries. Also, Nessi et al. (5) reported that digital panoramic images could increase the accuracy of dental investigations comparing with the conventional methods. Similarly, Shrout et al. (12) showed that the enhancement of digital panoramic images could improve the diagnosis of dental caries. Although our results showed high agreement rate between DR and CR images in the detection of proximal dental caries, the accuracy of both digital techniques is still behind bitewing radiography. Similar studies also introduced digital radiography as a good companion for the diagnosis of caries (13-17). Taylor-Weetman et al. (18) conducted a systematic review to compare panoramic and bitewing radiography for the detection of dental caries and reported that bitewing radiographies are likely to be more accurate for the detection of dental caries than panoramic radiographies. However, they also reported that these results may be particularly true for the detection of proximal caries and

caries that are confined to dentine, which was similar to the findings of the present study.

Conclusion

According to the results of this study and also the absence of any significant differences between DR and CR techniques they could be good imaging techniques for the detection of dental caries as a companion to clinical examinations.

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