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Consistency of Digital Panoramic Results Compared to Digital Periapical in Evaluation of Bone Loss in Anterior and Posterior Mandible and Maxilla

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ABSTRACT

This study evaluated the consistency of digital panoramic results compared to digital periapical in evaluation of bone loss in anterior and posterior mandible and maxilla. For this purpose, 10 patients with digital panoramic images and parallel and digital full mouth periapical referred to the private department of radiology were recruited for the study. Images of the patients were used for the study if they consented. The patients (aged 17±38) had moderate and severe periodontitis in teeth 2, 3, 4, 5, 6 and 7. The distance between CEJ and bone height observed on the mesial and distal lateral incisors, canines, first and second premolars, first and second molars in periapical and panoramic images was measured by a measurement tool available in the software. Bone loss in the cement and enamel junction to alveolar bone crest in the mesial and distal lateral incisors, canines, first and second premolars, first and second molars was measured and recorded in the questionnaire by considering magnification. Measurements were done by a radiologist and two dental students and repeated in 2 weeks. There was no significant difference in two images in the teeth 2, 3, 4, 5, 6 and 7 on the right and left. Therefore, PA can be replaced by panoramic imaging in these teeth.

Key words: Digital Panoramic, Bone Loss, Panoramic Radiography, PA Radiography

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INTRODUCTION

Periodontitis is an inflammatory disease of the tissues supporting the teeth; periodontitis is caused by certain microorganisms and associated with extensive destruction of periodontal ligament and alveolar bone. Periodontitis is revealed by forming pocket or gingival recession or both. Periodontal disease causes changes in alveolar bone [1]. Alveolar bone loss caused by periodontal disease is a leading cause of tooth loss. Height of alveolar bone is kept consent by balance of two bone formation and bone resorption processes. Periodontal disease disrupts this balance and leads to predominance of bone loss process and subsequently reduction of bone height. Proper diagnosis and timely treatment requires clinical and para-clinical examination [2]. The methods used to assess presence and extent of periodontitis includes probing and radiography. The former reflects the status of soft tissue and the latter reflects the situation and extent of damage to the hard tissue and spread of the disease [3]. Radiography plays an important role in assessing and controlling bone changes made during the disease process and treatment. Therefore, it is particularly important to select the correct and standard technique which is able to determine periodontal structures and expose the patients to the least dose [4]. Panoramic and periapical radiographies are common techniques of bone analysis. However, the most common problem is their inability to determine minor bone

changes [5]. The distance of C.E.J to alveolar crest was measured by using panoramic radiography and the results were compared with surgical results. Results of the study showed that panoramic radiography is reliable in estimating the size of alveolar bone resorption compared to surgery. Popova, Mlachkova and Emilov [6] reported that panoramic technique was less precise in showing alveolar crest and alveolar bone resorption than parallel periapical. Esmaeli *et al.,*evaluated precision of panoramic radiography, periapical radiography and bitewing in determining alveolar bone resorption. The results showed a significant difference between vertical bitewing and periapical radiography and reality. In this study, none of the radiographies was preferred over each other; however, panoramic radiography was highly precise in determining bone resorption by considering value of magnification[7]. De Faria Vasconcelos *et al.,* evaluated precision of vertical bitewing and bisector apical in evaluating alveolar bone resorption. Findings showed a significant difference in alveolar bone resorption between vertical bitewing and bisector apical radiography in anterior mandible and its real value. However, there was no significant difference between these two techniques in evaluating alveolar bone resorption in anterior mandible [8]. Esmaeli *et al.,*[7] measured precision of digital and conventional radiography in evaluating alveolar bone resorption. Digital radiography outperformed conventional radiography. Results of digital radiography were close to reality and were not significantly different from the golden standard. Haghgoo *et al.*, evaluated the precision of E-speed intraoral films, the intraoral digital systems PSP and CCD in determining bone resorption. Conventional and digital bitewing relatively outperformed digital panoramic imaging in terms of variations, mean difference in the obtained sizes to the gold standard, as well as the number of levels displayed. Because periapical and panoramic radiographies are commonly prescribed by dentists, it is essential to provide information on the type, severity and position of periodontal disease. This study determines precision of periapical and digital panoramic radiographies in evaluating alveolar bone resorption[9].

MATERIAL AND METHODS

This was a descriptive, accuracy and diagnostic study. The studied population included people whose accurate examinations revealed their need for dental radiographies. Ten patients with digital panoramic images and parallel and digital full mouth periapical referred to the private department of radiology were recruited for the study. Images of the patients were used for the study if they consented. Those eligible for the study were identified; sampling continued consecutively to reach the sample size. The samples (mean age 38 ± 17) had moderate and advanced periodontitis disease in the teeth 2, 3, 4, 5, 6 and 7. Patients with hypertension, diabetes, hepatitis, AIDS, pregnancy and addiction were excluded. Unexplainable images were also excluded. Panoramic imaging was performed by Plan meca EC, Finland, with 60 KVP, 4 mA, 18s exposure; PA imaging was done by Planmeca, Finland, with 60 KVP, 8 mA, 0.25s exposure using PSP sensors Size 2.Radiology was done in a standard form. It is noteworthy that all available radiographies were evaluated in terms of magnification and distortion; non-standard and faulty stereotypes were redone. Finally, the distance between CEJ and bone height observed on the mesial and distal lateral incisors, canines, first and second premolars, first and second molars in periapical and panoramic images was measured by a measurement tool available in the software. Bone resorption was measured at the cemento enamel junction to crest of the alveolar bone in the considered teeth and recorded in the questionnaire by considering magnification. Measurements were done by a radiologist and two dental students and repeated in 2 weeks. Based on the values obtained, the considered teeth were categorized in terms of bone resorption. These categories included:

- 0-1.5 mm: normal
- 1.6-3 mm: low bone loss
- 3.1-4.5 mm: moderate bone loss
- More than 4.5 mm: severe bone loss

This size was recorded in the information form. The software SPSS (Statistical Package for Social Sciences), Version 18, was used to analyze data. The kapp factor was used to evaluate consistency.

RESULTS

The CEJ/BL(Cemento Enamel Junction to Bone Level) size of 480 samples was measured by digital panoramic radiography and digital periapical radiography. The measurement was done by two dental students and a radiologist three times. The results are presented in Table 1. The table below shows CEJ/BL size measured by the radiologist in the panoramic radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.

Table 1: CEJ/BL size in panoramic radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PAN	L	1	1	2.1	1.5	1	1	1.5	1.5	1.9	1.5	1	1
		R	1.2	1	1	1	1.9	1	1	2	1	1	1	1.3
2	PAN	L	2.3	2.5	1	1	2.5	3	2	3	1.9	1.5	1.3	1.2
		R	1.3	1	1.3	1.6	2	2.4	2.5	3	2.1	2	1.5	1.5
3	PAN	L	1	1	1.3	1.4	2.4	3	3.4	4	4.5	3.4	4.5	3
		R	1.4	1.4	1	1	2	1	1.5	2	4	4.3	4	3
4	PAN	L	3.4	3	4	4.5	5.5	5.5	2.9	2	2.5	3	5.5	3.5
		R	2.5	3	2	1.5	4	3.4	4.5	2.5	5.5	3.5	6	6.5
5	PAN	L	1.2	1.4	1.5	1	3.4	2.4	3.5	2.9	4.5	3.2	3	2.5
		R	0.9	1	1	1	1	1.2	2	1.5	4.3	4	3.5	2
6	PAN	L	1	1	1	1	1.2	1.5	2.4	2.6	5	3.5	3	2.5
		R	0.5	1	0.9	0.9	2.3	2	2.5	2.9	3.5	3	5.5	4.5
7	PAN	L	1	1	2.4	3	2.3	2.5	1.5	1.9	4.5	3.2	2.1	2
		R	4.5	3	3.5	2	2.9	3	2.3	3.5	4.5	3.9	4.5	2.3
8	PAN	L	1.1	1.1	0.9	0.5	1	1	1.5	1.9	2.4	1.9	2.7	2.1
		R	1	1	1	1	1.3	1.5	1.5	2	2.9	2.5	3	2.3
9	PAN	L	3.1	3.2	2.9	3.1	2	2.1	2.1	1.9	4.3	3.5	4.1	3.1
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4.1	2
10	PAN	L	2.9	2.6	1.9	2	1.9	1.8	2	2	3.1	2.5	3.5	2

Table 1: CEJ/BL size in digital periapical radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PA	L	0.9	1	2.5	1.8	1	1.5	1.5	2	2	1.5	1.5	1
		R	1.3	1.1	1	1	2.1	1	1	2.3	1	1.2	1.2	1.5
2	PA	L	2.5	2.5	1	1.4	2.5	3	2.2	3	2	1.5	1.5	1.2
		R	1.5	1	1.5	1.8	2.2	2.5	2.5	3	2	2	1.5	1.5
3	PA	L	1	1	1.5	1.5	2.5	3	3.5	4	4.3	3.5	4.5	2.8
		R	1.5	1.5	1	1	2	1	1.5	2	4	4	4	3
4	PA	L	3.5	2.2	3.8	4.5	5.5	5.5	3	2	2.5	3	5.5	3.5
		R	2.5	3	2	1.5	4	3.5	4.5	2.5	5.5	3.5	6	6.5
5	PA	L	1.2	1.4	1.5	1.1	3.4	2.4	3.5	2.9	4.5	3.2	3	2.5
		R	0.9	1	1.1	1	1.5	1	2	1.5	4.5	4	3.5	1.8
6	PA	L	1	1	1	1.2	1	1.5	2.5	2.6	5.3	3.7	3.2	2.5
		R	0.5	1.2	1	1	2.3	2	2.5	2.9	3.5	3	5.5	4.5
7	PA	L	1	1	2.2	2.7	2	2.5	1.5	2	4.5	3	2	2
		R	4.2	3	3.5	2	2.9	3	2	3.5	4.5	3.9	4.5	2.2
8	PA	L	1.1	1	0.5	0.5	1	1	1.5	2	2.4	1.9	2.7	2.1
		R	0.9	1	1	1	1	1.5	1.5	2	2.9	2.5	3.1	2.2
9	PA	L	3.3	3.2	2.9	3.1	2	2.1	2.1	1.9	4.3	3.5	4.3	3
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4.5	2
10	PA	L	2.9	2.6	1.9	2.2	1.9	1.8	2	2	3.1	2.5	3.5	2
		R	3.3	3	2.2	2.1	2.5	2.5	1.9	1.8	3	2.5	2.5	2.7

Table 2: CEJ/BL size in panoramic radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PAN	L	1	1	2.1	1.5	1	1	1.5	1.5	2	1.5	1	1
		R	1.2	1	1	1	1.9	1	1	2	1	1	1	1.3
2	PAN	L	2.3	2.5	1	1	2.5	3	2	3	1.9	1.5	1.3	1.2
		R	1.3	1	1.3	1.6	2	2.4	2.5	3.1	2.1	2	1.5	1.5
3	PAN	L	1	1	1.3	1.4	2.5	3	3.4	4	4.5	3.4	4.5	3
		R	1.4	1.5	1	1	2	1	1.5	2	4	4.3	4	3.2
4	PAN	L	3.5	3	4	4.5	5.5	5.5	2.9	1.9	2.5	3	5.5	3.5
		R	2.5	3	2	1.5	4	3.4	4.5	2.5	5.5	3.5	6	6.5
5	PAN	L	1.2	1.4	1.5	0.9	3.4	2.4	3.5	2.9	4.5	3.2	3	2.5
		R	0.9	1	1	1	1	1.2	2	1.5	4.3	4	3.5	2
6	PAN	L	1	1	1	1	1.2	1.5	2.4	2.6	5	3.5	3	2.5
		R	0.5	1	0.9	0.9	2.3	2	2.5	2.9	3.5	3	5.5	4.5
7	PAN	L	1	1	2.4	3	2.3	2.5	1.5	1.9	4.5	3.2	2.1	2
		R	4.5	3	3.5	2	2.9	3	2.1	3.5	4.5	3.9	4.5	2.3
8	PAN	L	1.1	1.1	0.9	0.5	1.2	1	1.5	1.9	2.4	1.9	2.7	2.1
		R	1	1.1	1	1	1.3	1.5	1.5	2	2.9	2.5	3	2.3
9	PAN	L	3.1	3	2.9	3.1	2	2.1	2.1	1.9	4.3	3.5	4.1	3.1
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4.1	2
10	PAN	L	2.9	2.6	1.9	2	1.9	1.8	2	2.3	3	2.5	3.5	2
		R	3.1	3	2.1	2.1	2.5	2.5	1.9	1.8	3	2.5	2.5	2.7

Table 3: CEJ/BL size in digital periapical radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PA	L	0.9	1	2.5	1.5	1	1.5	1.5	2	2	1.5	1.5	1
		R	1.3	1.1	1	1	2.1	1	1	2.3	1	1.2	1.2	1.5
2	PA	L	2.5	2.5	0.9	1.4	2.5	3.5	2.2	3	2	1.5	1.5	1.2
		R	1.5	1	1.5	1.8	2.2	2.5	2.5	3	2	2	1.5	1.5
3	PA	L	1	0.9	1.5	1.5	2.5	3	3.5	4	4.3	3.5	4.5	2.8
		R	1.5	1.5	1.2	1.2	2	1.5	1.5	2	4.1	4	4	3
4	PA	L	3.5	2.2	3.8	4.5	5.5	5.5	3	2	2.5	3	5.5	3.5
		R	2.2	3	2	1.5	4	3.5	4.5	2.5	5.5	3.5	6.5	6.5
5	PA	L	1.2	1.4	1.5	1.1	3.4	2.4	3.5	2.9	4.5	3.2	3	2.5
		R	0.9	1	1.1	1	1.5	1	2	1.5	4.5	4	3.5	1.8
6	PA	L	1	1	1	1.2	1	1.5	2.5	2.6	5.3	3.7	3.2	2.5
		R	0.5	1.2	1	1	2.3	2	2.5	2.9	3.5	3	5.5	4.5
7	PA	L	1	1	2.2	2.7	2	2.5	1.5	2	4.5	3	2	2
		R	4.2	3	3.5	2	2.9	3	2	3.5	4.5	3.9	4.5	2.2
8	PA	L	1.1	1	0.5	0.5	1.1	1	1.5	2	2.4	1.9	2.7	2.1
		R	0.9	1	1	1	1	1.5	1.5	2	2.9	2.5	3.1	2.2
9	PA	L	3.3	3.2	2.9	3.1	2.2	2.1	2.1	1.9	4.3	3.5	4.3	3.5
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4.5	2
10	PA	L	2.9	2.6	1.9	2.2	1.9	1.8	2	2	3.1	2.5	3.5	2
		R	3.3	3	2.2	2.1	2.5	2.5	1.9	1.8	3	2.5	2.5	2.7

Table 4: CEJ/BL size in digital panoramic radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PAN	L	1	1	2	1.5	1	1	1.5	1.5	1.9	1.5	1	1
		R	1.2	1	1	1	1.9	0.9	1	2	1	1	1	1.3
2	PAN	L	2.3	2.5	1	1	2.5	3	2	3	1.9	1.5	1.3	1.2
		R	1.3	1	1.3	1.6	2	2.4	2.5	3	2	2	1.5	1.5
3	PAN	L	1	1.2	1.3	1.5	2.4	3	3.4	4	4.5	3.4	4.5	3
		R	1.4	1.5	1	1	2	1	1.5	2	4	4.3	4	3
4	PAN	L	3.4	3	4	4.5	5.5	5.5	2.9	2	2.5	3	5.5	3.3
		R	2.5	3	2	1.5	4	3.4	4.5	2.5	5	3.5	5.5	6
5	PAN	L	1	1.4	1.5	1	3.4	2.4	3.5	2.9	4	3.2	3	2.5
		R	0.9	1	1	1.2	1	1.2	2	1.5	4.5	3.8	3.5	2
6	PAN	L	1	1	1	1	1.2	1.5	2.5	2.6	5	3	3	2.5
		R	0.5	1	0.9	0.9	2.5	2	2.5	2.9	3.5	3	5.5	4.5
7	PAN	L	1	1	2.4	3	2.3	2.5	1.5	1.9	4.5	3.2	2.1	2
		R	4.5	3	3.5	2	2.9	3	2.3	3.5	4.5	3.9	4.5	2.3
8	PAN	L	1.1	1	0.9	0.5	1	1	1.5	1.9	2.8	1.9	2.7	2.1
		R	1	1	1	1	1.3	1.5	1.5	2	2.9	2.5	2.5	2
9	PAN	L	3.1	3.2	2.9	3	2	2.1	2.1	1.9	4.3	3.5	4.1	3.1
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4	2
10	PAN	L	2.8	2.5	1.9	2	1.9	1.8	2	2	3	2.5	3.5	2
		R	3.1	3	2.1	2	2.5	2.5	1.9	1.8	3	2.5	2.5	2.7

Table 5: CEJ/BL size in digital periapical radiography of mesial and distal teeth

Sample	Graph	Side	M2	D2	M3	D3	M4	D4	M5	D5	M6	D6	M7	D7
1	PAN	L	1	1	2	1.5	1	1	1.5	1.5	1.9	1.5	1	1
		R	1.2	1	1	1	1.9	0.9	1	2	1	1	1	1.3
2	PAN	L	2.3	2.5	1	1	2.5	3	2	3	1.9	1.5	1.3	1.2
		R	1.3	1	1.3	1.6	2	2.4	2.5	3	2	2	1.5	1.5
3	PAN	L	1	1.2	1.3	1.5	2.4	3	3.4	4	4.5	3.4	4.5	3
		R	1.4	1.5	1	1	2	1	1.5	2	4	4.3	4	3
4	PAN	L	3.4	3	4	4.5	5.5	5.5	2.9	2	2.5	3	5.5	3.3
		R	2.5	3	2	1.5	4	3.4	4.5	2.5	5	3.5	5.5	6
5	PAN	L	1	1.4	1.5	1	3.4	2.4	3.5	2.9	4	3.2	3	2.5
		R	0.9	1	1	1.2	1	1.2	2	1.5	4.5	3.8	3.5	2
6	PAN	L	1	1	1	1	1.2	1.5	2.5	2.6	5	3	3	2.5
		R	0.5	1	0.9	0.9	2.5	2	2.5	2.9	3.5	3	5.5	4.5
7	PAN	L	1	1	2.4	3	2.3	2.5	1.5	1.9	4.5	3.2	2.1	2
		R	4.5	3	3.5	2	2.9	3	2.3	3.5	4.5	3.9	4.5	2.3
8	PAN	L	1.1	1	0.9	0.5	1	1	1.5	1.9	2.8	1.9	2.7	2.1
		R	1	1	1	1	1.3	1.5	1.5	2	2.9	2.5	2.5	2
9	PAN	L	3.1	3.2	2.9	3	2	2.1	2.1	1.9	4.3	3.5	4.1	3.1
		R	3.4	3.1	3	3.2	2.4	2.6	3.1	2	4	2.4	4	2
10	PAN	L	2.8	2.5	1.9	2	1.9	1.8	2	2	3	2.5	3.5	2
		R	3.1	3	2.1	2	2.5	2.5	1.9	1.8	3	2.5	2.5	2.7

Table 6: difference in panoramic radiography and PA radiography of the tooth NO.2 left

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	12 (60.0%)	3 (15.0%)	5 (25.0%)	20 (100%)
PA	12 (60.0%)	3 (15.0%)	5 (25.0%)	20 (100%)

Table 7: difference in panoramic radiography and PA radiography of the tooth NO.2 right

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	11 (55.0%)	7 (35.0%)	2 (10.0%)	20 (100%)
PA	12 (60.0%)	6 (30.0%)	2 (10.0%)	20 (100%)

Table 8: difference in panoramic radiography and PA radiography of the tooth NO.3 left

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	11 (55.0%)	7 (35.0%)	2 (10.0%)	20 (100%)
PA	11 (55.0%)	7 (35.0%)	2 (10.0%)	20 (100%)

Table 9: difference in panoramic radiography and PA radiography of the tooth NO.3 right

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	12(60.0%)	5 (25.0%)	3 (15.0%)	20 (100%)
PA	11 (55.0%)	6 (30.0%)	3 (15.0%)	20 (100%)

Table 10: difference in panoramic radiography and PA radiography of the tooth NO.4 left

Graphi * response	NORMAL	MILD	MODERATE	SEVERE	Total
Panoramic	5 (25.0%)	12 (60.0%)	2 (10.0%)	1 (5.0%)	20 (100%)
PA	5 (25.0%)	12 (60.0%)	2 (10.0%)	1 (5.0%)	20 (100%)

Table 11: difference in panoramic radiography and PA radiography of the tooth NO.4 right

Graphi * response	NORMAL	MILD	MODERATE	SEVERE	Total
Panoramic	7 (35.0%)	11 (55.0%)	1 (5.0%)	1 (5.0%)	20 (100%)
PA	7 (35.0%)	11 (55.0%)	1 (5.0%)	1 (5.0%)	20 (100%)

Table 12: difference in panoramic radiography and PA radiography of the tooth NO.5 left

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	6 (30.0%)	10 (50.0%)	4 (20.0%)	20 (100%)
PA	6 (30.0%)	10 (50.0%)	4 (20.0%)	20 (100%)

Table 13: difference in panoramic radiography and PA radiography of the tooth NO.5 right

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	2 (10.0%)	16 (80.0%)	2 (10.0%)	20 (100%)
PA	1 (5.0%)	17 (85.0%)	2 (10.0%)	20 (100%)

Table 14: difference in panoramic radiography and PA radiography of the tooth NO.6 left

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	2 (10.0%)	16 (80.0%)	2 (10.0%)	20 (100%)
PA	1 (5.0%)	17 (85.0%)	2 (10.0%)	20 (100%)

Table 15: difference in panoramic radiography and PA radiography of the tooth NO.6 right

Graphi * response	NORMAL	MILD	MODERATE	Total
Panoramic	3 (15.0%)	9 (45.0%)	8 (40.0%)	20 (100%)
PA	3 (15.0%)	9 (45.0%)	8 (40.0%)	20 (100%)

Table 16: difference in panoramic radiography and PA radiography of the tooth NO.7 left

Graphi * response	NORMAL	MILD	MODERATE	SEVERE	Total
Panoramic	4 (20.0%)	6 (30.0%)	7 (35.0%)	3 (15.0%)	20 (100%)
PA	4 (20.0%)	4 (20.0%)	9 (45.0%)	3 (15.0%)	20 (100%)

Table 17: difference in panoramic radiography and PA radiography of the tooth NO.7 right

Graphi * response	NORMAL	MILD	MODERATE	SEVERE	Total
Panoramic	4 (20.0%)	12 (60.0%)	3 (15.0%)	1 (5.0%)	20 (100%)
PA	4 (20.0%)	13 (65.0%)	2 (10.0%)	1 (5.0%)	20 (100%)

The Table 2 shows CEJ/BL size measured by the radiologist in the digital periapical radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.The Table 3 shows CEJ/BL size measured by the dental student in the panoramic radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.

The Table 4 shows CEJ/BL size measured by the dental student in the digital periapical radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.

The Table 5 shows CEJ/BL size measured by the dental student in the digital panoramic radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.

The Table 6 shows CEJ/BL size measured by the dental student in the digital periapical radiography of mesial and distal teeth 2, 3, 4, 5, 6 and 7.

In general, statistical analyses of data are presented below.

As shown in Table 7, there is no significant difference between two radiographies in the tooth NO.2 left (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 8, there is no significant difference between two radiographies in the tooth NO.2 right (p-value=0.942). Thus, PA can be replaced by panoramic radiography.

As shown in Table 9, there is no significant difference between two radiographies in the tooth NO.3 left (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 10, there is no significant difference between two radiographies in the tooth NO.3 right (p-value=0.935). Thus, PA can be replaced by panoramic radiography.

As shown in Table 11, there is no significant difference between two radiographies in the tooth NO.4 left (p-value=0.935). Thus, PA can be replaced by panoramic radiography.

As shown in Table 12, there is no significant difference between two radiographies in the tooth NO.4 right (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 13, there is no significant difference between two radiographies in the tooth NO.5 left (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 14, there is no significant difference between two radiographies in the tooth NO.5 right (p-value=0.834). Thus, PA can be replaced by panoramic radiography.

As shown in Table 15, there is no significant difference between two radiographies in the tooth NO.6 left (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 16, there is no significant difference between two radiographies in the tooth NO.6 right (p-value=1). Thus, PA can be replaced by panoramic radiography.

As shown in Table 17, there is no significant difference between two radiographies in the tooth NO.7 left (p-value=0.885). Thus, PA can be replaced by panoramic radiography.

As shown in Table 18, there is no significant difference between two radiographies in the tooth NO.7 right (p-value=0.971). Thus, PA can be replaced by panoramic radiography.

DISCUSSION

Early and correct diagnosis reveals the key point in treatment of periodontal disease, particularly in the advanced stages. One of the criteria for determining severity of the disease is to measure bone loss on radiographs of the patient. This study was conducted by considering high value of radiography in diagnosis and decision making for treatment of a variety of periodontitis. Many factors such as angle of X-rays, resorbed bone, type of film, and skill of the technician in diagnostic accuracy of radiography, accuracy and diagnostic value of conventional radiography techniques are important in diagnosis of periodontitis. Kelly [10] found that clinical

diagnosis of the disease by probing and clinical measurement of pocket depth was more valuable and valid than radiography. Kelly noted that radiographic evaluation of results of periodontal treatment is useful only if a large number of patients are evaluated. Källestål and Matsson [11] measured the normal CEJ/AC distance by using bitewing radiography. The measurement was done on 30 subjects aged 18 with healthy gingiva. After clinical examinations and four posterior B.W, the sites with probing-caused bleeding, incorrect fillings or plaque were excluded from the study. CEJ/AC distance was measured in the 237 sites remaining. In maxilla, CEJ/AC distance varied from 1 to 0.9 mm, on average. CEJ/AC distance was 0.78 mm in mandible, except in mesial mandibular first and second premolar which was 0.5 mm, on average. CER/AC distance was 1 mm in 86-90% of maxillary molars. CEJ/AC was 1.5 mm in 94-100% of mandibular molars. CEJ/AC was 2 mm in four mesial maxillary first and second premolars. In the current study, CEJ/AC distance was normal (1.5 mm). Through a multinational study, Critchlow *et al*., (1995) analyzed the prevalence of alveolar bone loss in people aged 15-17. Using BW, they studied 8703 people in 16 countries. Bone loss was observed in 10.2% of cases. At this age, bone loss was predominantly horizontal in the mesial upper first molar followed by distal upper first molar. In the present study, evaluation was performed in the mesial and distal bone loss considering the prevalence of horizontal bone loss. Yukna and Yukna [12] compared conventional PA and panoramic radiography used for measuring alveolar bone loss and surgical sizes of CEJ/AC distance. Almost 5027 proximal surfaces were evaluated in 2536 teeth of 100 patients with periodontitis during periodontal flap surgery by using conventional PA and panoramic radiography. The results indicated 1-4 mm bone destruction in panoramic radiography and 1-2 mm in conventional PA. Conventional PA was more accurate than panoramic radiography in showing loss of alveolar small lesions, while PA was more accurate than panoramic radiography in advanced periodontitis lesions. The studies conducted on alveolar bone loss usually evaluate parallel PA, because it is standard. Since the purpose of this study was to evaluate available radiographies for studying periodontal diseases, panoramic radiography was also taken into account. Chhem and Brothwell [13] claimed that anatomic access of radiographic images depends on correct type of techniques, including film, X-ray angle, object to film distance and film to focus distance. This study showed that parallel technique made minimum dimensional changes. The present study used parallel technique to make minimum dimensional changes. Tugnait and Clerehugh [14] showed that panoramic radiography was not consistent with clinical evaluation of gingival disease. In this approach, panoramic radiography was used as an auxiliary diagnostic value for changes made. To use panoramic radiography as a better diagnostic procedure, it can be supplemented by intraoral radiography. This study is different from the current study in the technique used. The current study compared the results of PA and panoramic techniques; it was found that panoramic technique was acceptably accurate. Soikkanen [15] used panoramic radiography to measure CEJ/AC distance compared to surgical results. There was no significant difference (mean=0.08, t-value>0.05). Thus, panoramic radiography was reliable in estimating alveolar bone loss compared to surgery. This is consistent with the current study. Using radiography, Diamanti- Kipioti *et al*[16] evaluated 165 people with periodontitis (61 men and 104 women). They used parallel PA and BW for the patients. The film was developed by an automatic developer and fixer machine. Radiographs were evaluated by computer software. The results showed that proximal regions were clearer in BW. Compared to the current study, the different results can be attributed to the methodology and instruments measured. Sheikhi *et al*[17] estimated alveolar bone loss in the mesial and distal upper and lower teeth 4, 5 and 6 in 12 patients (3 men and 9 women) aged 35 and referred to periodontology of the Isfahan Dental School by using BW, PA and panoramic radiography. Out of 48 regions measured during surgery, the mean bone loss was 4.27 mm in clinic, 2.62 mm in bisector AP, 2.98 mm in vertical BW, 4.8 mm in panoramic radiography and 4.05 mm in panoramic radiography considering magnification. The results indicate very low accuracy and a significant difference between BW, PA and reality. None of the radiographies was preferred over others, while panoramic radiography was highly accurate in determining BL and CEJ. These findings are consistent with the current study. Ackerman and Banning [18] compared radiographic measurements of alveolar crest loss by panoramic radiography, parallel PA and BW and determined the type of film and the best type of radiography for more accurate estimation of alveolar bone. They suggested integration of BW

and parallel PA for evaluating complete intraoral set. A strong relationship was found between complete intraoral set and panoramic radiography. These findings are consistent with the current study. In both studies, panoramic technique was acceptably accurate in estimating bone loss. Yan *et al* examined the relationship between bone probing, radiographic and histometrical measurements. CEJ/AC distance was created on 24 intraosseous lesions in the second and fourth premolars and mandibular sixth molar of dogs. The result of this study was the difference in mean CEJ/AC distance in panoramic radiography with histometrical size (0.73) and the difference in mean CEJ/AC distance in panoramic radiography with surgical size (0.6), which was not significant. Thus, panoramic radiography was accurate in measuring CEJ/AC distance[19]. The current study evaluated accuracy of CEJ/AC distance measurement in periodontal lesions by two techniques including panoramic radiography and parallel PA. Results of panoramic radiography were not significantly different from PA, which indicates accuracy of this technique in measuring CEJ/AC distance.

CONCLUSION

For some reasons, panoramic radiography can be preferred over other radiographies in determining bone loss and general examination of jaws. These reasons may include simultaneous examination of jaws in a stereotype, simpler procedure, lower cost and time required, which is helpful in comparative analyses in different times. No significant difference was found between two radiographies. Thus, PA can be replaced by panoramic radiography. Considering the results, it is suggested to:

1. Use PA if panoramic radiography is not able to detect in a region of the jaw.
2. Use panoramic radiography to reduce radiation dose for intraoral completion and alveolar bone detection.
3. Use both techniques for resolution and representation of anatomic details in intraoral radiography (parallel PA and BW).

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