

Comparison Accuracy Study of E Speed Intraoral Films and Extraoral PSP Digital Panoramic System, for Identifying the Extent of Alveolar Bone Destruction in Anterior Maxillary Region of Periodontitis Patients

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Background: Radiographs play an integral role in the assessment of periodontal disease. In recent years, advent of digital imaging has revolutionized radiology in dentistry.

Objectives: The aim of this study was to compare the E speed intra oral films and extra oral digital systems in identifying the extent of alveolar bone loss in anterior maxillary region of periodontitis patients.

Patients and Methods: In this diagnostic accuracy study, 48 inter proximal surfaces were evaluated in eight patients. These patients had alveolar bone loss in anterior regions because of periodontitis. Intraoral (parallel peri-apical) and extra oral (PSP: panoramic-photo-stimulable phosphor) radiography were taken from all the patients. The distance between Cemento-Enamel Junction (CEJ) to the alveolar crest was measured in radiographies. This distance was compared with the surgical distance as gold standard.

Results: Accuracy differences between conventional E speed films and digital extra oral system are not statistically significant. All two radiographic modalities in comparison with surgical gold standard have significant difference and both underestimate the extent of bone loss.

Conclusions: According to this study, accuracy of two imaging systems in assessment of alveolar crest bone loss level is nearly equal. Digital panoramic instead of intraoral film-based radiography can be used in periodontitis patients.

Keywords: Alveolar Bone Loss; Radiography, Dental; Periodontitis

1. Background

Many people experience periodontal disease worldwide. Periodontitis is one of the periodontal diseases that accounts of great importance due to high rate of prevalence and complications (mobility and tooth loss). Diagnosis of location, depth and configuration of periodontal osseous lesions are important for determining prognosis, treatment plan and maintaining teeth in long term (1). Measurement of bone loss amount can be achieved by re-entry surgery or microscopic evaluation, but these methods are aggressive and consumes time and cost (2).

Radiography is an acceptable method for preliminary evaluation of periodontal osseous lesions (3). Radiographic modalities provide incomparable information from periodontal condition, such as available bone amount, alveolar crest condition, bone loss in furcation region and periodontal ligament (PDL) space (4). Despite all of this, conventional radiographs (taken before periodontal treatments) often cannot determine accurate depth of osseous defect and underestimate it from the real amount (5). Since introduction of digital radiography and promotion of this technology, this method is largely used in dentistry

(4). Most remarkable advantages of digital radiography are data processing, image enhancement and manipulation (6). Other advantages that can be mentioned are reduction of patient dose, image storage, better infection control and easy processing (7). In this study, we compared accuracy of conventional intraoral radiography with panoramic digital system in evaluating alveolar bone loss; considering the above mentioned advantages and increasing usage of digital radiography. Panoramic modality is, of course, the most common radiography; most of the patients come to us with a panoramic image in hand. Better quality of these images can result to create other indications to it, in addition to the most focused use (screening). As we know, panoramic modality is not accurate in evaluation of anterior segments, but different diagnostic accuracy can be achieved as technology improves.

2. Objectives

Our aim was to compare this PSP method with the common periapical modality.

3. Patients and Methods

In this accuracy evaluation study, 48 interproximal surfaces (anterior maxillary teeth) were selected to be evaluated. Patients were selected from the referred ones to the periodontal department of Hamadan Dental School in 2013, all needed periodontal surgery according to periodontist confirmation. The inclusion criteria were as follow: 1- Experiencing periodontitis, 2- Indication of periodontal surgery, 3- No contraindication of taking radiographies, 4- Teeth without proximal caries or filling, fixed prosthesis, rotation or tilt, crowding or semi erupted.

Dental radiographs were taken including intraoral parallel periapical and extraoral digital panoramic (PSP, sordex) after initial examination and phase one therapy (scaling and root planning). Distance between CEJ to alveolar crest was measured by digital ruler. The most apical part of the radioopacity was considered as CEJ. Radiographic evaluations were with the same condition. Superimposition of vertebra can occur in the anterior maxillary region; so conventional periapical radiography was also prepared from the patients. One single technician took all the images. In intraoral radiographs, patients sit up right on the chair and the head was supported by the head set, so the sagittal plan was imposed to horizontal level. We used E speed film (Kodak, USA) and RINN film holder. Automatic processor (Hope, USA) was used with the tetenal developing and processing solution. Concentration, time and temperature (28°C) were equal for all the images. Radiographs were repeated if the density, contrast, horizontal and vertical angulation were incorrect.

Panoramic images were taken by Sordex machine under 70 kvp, 10 MA, 17.2 s. panoramic images also were repeated if patients position was not correct. Digital coulis was used in conventional film radiographs (Mituyoto, Japan, 0.01 mm accuracy) (Figure 1).

We allowed the two periodontist observers to manipulate digital images (contrast and brightness) to achieve the best condition. It is important to mention that the measurements were done after image calibration (omitting magnification).

After taking all the radiographies, periodontal surgery was done. The duration between images and the surgery was not longer than 4 weeks. All of the surgeries were done by one periodontist, who was blind to the radiographic condition. Appropriate surgical technique was selected to achieve proper vision and access. Distance between CEJ reference point and alveolar bone crest was measured after incision and flap elevation and before os-

seous recounting. Measurement was done by a periodontal probe, marked by rubber point and finally, measured by digital coulis. The surgical distance was considered as gold standard. Treatment stages were done and flap was sutured at the end of the process.

The gold standard amount was compared with the two radiographic modalities. SPSS 16 for Windows (SPSS Inc., Chicago, IL, USA) was used to analyze data. Repeated measurement analysis, post-hoc bonferroni and machli analysis were done. A P value of 0.05 was considered as significance level. Cohen's Kappa and interclass correlation coefficient (ICC), were used for intra and inter observer agreement.

4. Results

In this study, intra and inter observer agreement coefficient was in the range of significant increase. ICC showed appropriate agreement between intervals for both of the reviewers (0.93). We compared bone loss amount of anterior maxillary region bone crest and so the accuracy of periapical and panoramic images. We evaluated 48 interproximal surfaces by two radiography modality and also the gold standard. Mean and standard deviation of panoramic and periapical distances were near to each other (panoramic 5.34 ± 1.70 mm, preapical 5.41 ± 1.74 mm and surgery 6.04 ± 1.99 mm). Post-hoc bonferroni analysis was used to show the pair differences of the methods (Table 1).

Paired comparison of methods showed that there are no differences between panoramic and periapical radiography in assessment of maxillary anterior region. ($P = 1.00$). These two radiographic modalities have significant differences with the surgical gold standard. The mean amount of the panoramic measurements (5.34 mm) was lower than periapical (5.41 mm) method. Panoramic images showed greater difference from surgical gold standard (6.04 mm) comparing to periapical ones.



Figure 1. Measurement Distance between CEJ to Alveolar Bone Crest by Digital Coulis

Table 1. Paired Comparison of Measurement Methods by Post Hoc Bonferroni Test

Bone Loss (I)	Bone Loss (J)	Mean Difference (I-J), mm	Standard Error	P Value	Coefficient Interval %95
Panoramic	Periapical	0.069	0.153	1.000	0.448-0.310
Periapical	Panoramic	0.069	0.153	1.000	0.310-0.448
Surgery	Panoramic	0.696	0.167	0.000	0.28-1.112
	Periapical	0.627	0.215	0.016	0.093-1.160

5. Discussion

Radiographic evaluations are useful in assessing osseous defects and estimating bone loss amount. It can be used in diagnosis and estimation of periodontal disease progression (4). This study compared accuracy of these two image modalities, to answer this question that digital panoramic can be used instead of periapical modality or not. According to our findings, these two image modalities' measurements were significantly lower than surgical gold standard and this is one of the radiographies disadvantages. That is because that these radiographs are two dimensional image of a three dimensional position (4). Initial osseous lesions cannot show significant changes in radiographic images.

No significant differences were seen between digital panoramic and parallel periapical measurements. This finding in according to Eickholz et al. (8) that concluded that all the radiographic modalities underestimate the real amount of the bone loss. Baksi also stated that PSP accuracy is comparable with plain film in assessment of periodontal structures (9). Persson showed that panoramic can be used instead of full-mouth periapical in periodontitis patients (10).

These results can be justifiable by the digital panoramic calibration and reducing magnification. In this study, we calibrated images to omit magnification as mentioned before. Image enhancement was also used, that results in better quality of images. These results are concordant with Corbet study (11) that states digital panoramic is better than conventional panoramic in evaluating periodontal bone losses. Also Razi showed that digital radiographies (with or without enhancement) is more effective than conventional radiographies in assessment of low amount changes (12).

Parallel periapical images showed lower mean differences (-0.627 mm) in comparison with panoramic ones (-0.696 mm); however, this difference is not statistically significant. Based on studies of Li, Gomes and Faghihi that concluded that digital radiography is more accurate than plain film in assessment of periodontal bone loss (13-15) and Rebesco, Semenoff and Chitsazi that stated periapical is better than panoramic images (16-18), the results of this study can be supported by this reality that periapical images is better in detail evaluation, but with image enhancement of panoramic images, the difference can be reduced. On the other hand, in recent years, digital radiography machines have notably advanced such as larger focal trough size that causes better quality in anterior regions (4).

Based on the results of this study, no statistical significant differences between periapical and panoramic modalities were seen. Thus, digital panoramic images can be used instead of periapical full mouth images in periodontal patients. Digital images needs lower radiation dose, are taken more easily and their calibration can reduce magnification, which are accounted as its advantages on other modalities.

Authors' Contributions

Janet Moradi Haghgoo: study design, data acquisition; Abbas Shokri: study design, scientific consultation; Fate-meh Azizi: clinical studies, literature search; Nazli Rabi-enejad: manuscript preparation.

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