

Original Article

Assessment of digital panoramic radiography's diagnostic value in angular bony lesions with 5 mm or deeper pocket depth in mandibular molars

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ABSTRACT

Background: Assessment of alveolar bone level in periodontitis is very important in determining prognosis and treatment plan. Panoramic radiography is a diagnostic tool used to screen patients. The aim of the present study was to assess the diagnostic value of digital panoramic radiography in angular bony defects with 5 mm or deeper pocket depth in mandibular molars.

Materials and Methods: In this cross-sectional study, ninety angular bony defects in mandibular molars teeth with 5 mm or deeper pocket depth were selected in sixty patients with the diagnosis of chronic periodontitis. Before surgery, bone probing was performed. During the surgery, the vertical distance from cemento-enamel junction to the most apical part of bony defect was measured using a Williams probe and these measurements were employed as gold standard. This distance was measured on the panoramic radiographs by a Digital Calliper and Digital Ruler. All data were compared using independent samples *t*-test and Pearson's correlation coefficient.

Results: No significant difference was found between the results of bone probing and intra-surgical measurements ($P = 0.377$). The mean defect depth determined by Digital Caliper and Digital Ruler on panoramic radiographs was significantly less than surgical measurements ($P < 0.001$). The correlation between bone probing and surgical measurements in determining the defect depth was strong ($r = 0.98$, $P < 0.001$). Radiographic measurements made by Digital Ruler ($r = 0.86$), comparing to Digital Caliper ($r = 0.79$), showed a higher degree of correlation with surgical measurements.

Conclusion: Based on this study, bone probing is a reliable method in vertical alveolar bone defect measurements. While the information obtained from digital panoramic radiographs should be used with caution and the ability of digital panoramic radiography in the determination of defect depth is limited.

Key Words: Panoramic radiography, periodontal bone loss, periodontal disease

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INTRODUCTION

Among the oral cavity diseases, periodontitis is a major concern due to its high prevalence and

complications such as tooth mobility and tooth loss.^[1] Alveolar bone loss is a general sign of periodontitis

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which results from the release of inflammatory mediators such as interleukin 1, tumor necrosis factor alpha, and prostaglandin E2.^[2] These mediators reach the alveolar bone and disrupt the balance between resorption and apposition which leads to bone loss.^[3] Bone loss patterns are categorized into even defects and angular/vertical defects. In vertical or angular defects, the remaining alveolar bone forms an angle with the cemento-enamel junction (CEJ) of adjacent tooth and the end point of the defect is apical to the alveolar crest.^[4] Diagnosing the site, extension, and form of bone loss is important in determining the prognosis, treatment plan, and tooth vitality. Determining the depth and the extension of bone loss is an important parameter in diagnosis, prognosis, and treatment.^[5] Obviously, the most accurate method for evaluating bone level is direct measurement after flap deflection, but this method is very invasive and could cause patient discomfort and tooth supporting tissue injury.^[6]

Several studies have been investigating alternative accurate and noninvasive method for measuring bone level,^[7-9] including pocket depth probing, bone probing, and radiographic measurement are mentioned. The most frequent appliances for clinical diagnosis of periodontal disease and treatment outcome surveillance are periodontal probes and radiographic images.^[10] Radiographic images are very important in diagnosis, prognosis, and evaluation of periodontal diseases and help the dentist to assess the extension of alveolar bone destruction, local assisting factors and periodontium's conditions which affect the disease prognosis.

Panoramic imaging obtains a single tomographic image from facial structures including maxillary and mandibular dental arches and their supporting structures. Panoramic images are not suggested for evaluating periodontal disease because they underestimate small marginal bone destructions and overestimate extensive destructions.^[4] Panoramic images require less radiation and are timesaving. This method is a potential alternative for intraoral radiographs for evaluating periodontal conditions.^[11] It has been a very popular screening method,^[11] although it is less efficient in diagnosis compared to inter oral radiographs taken in office.^[12]

Regarding the frequent application of panoramic imaging and its known shortcomings, radiographic assessment can affect the master plan of periodontal treatment. This is particularly more important for

patients who are diagnosed as borderline cases for surgery.

In this study, we compared the depth of vertical bony defects measured by panoramic radiographs and bone probing under anesthesia, to evaluate their diagnostic value for determining the intensity of bone loss and extension of bony lesion.

MATERIALS AND METHODS

In this cross-sectional analytic study, 60 patients (36 women and 24 men) diagnosed as chronic periodontitis who required surgery, were selected. Their mean age was 44.5 years, and they all had been referred to the department of periodontics of the Dental Faculty of Rasht. Ninety vertical bony defects with 5 mm or more probing depth in the mandibular first and second molars were evaluated. Initially, digital panoramic radiographs (EC Praline Planmeca Helsinki, Finland) were obtained using the Konica Minolta digital system and photostimulable phosphor plates.

All radiographs were taken by the same device and exposing factors were adjusted according to the age and bulk of the patient to prevent the magnification effect. The positioning was carefully performed so that the highest quality and clear images of alveolar crest and dental regions were obtained.

If the quality of radiography was not adequate or none of the landmarks for measurement were clear, these cases were excluded from the study. Severe tooth destruction resulting from caries or if the apical portion of the restoration or caries were not determinable that tooth was eliminated from the study. An acrylic stent was made for each patient in the interproximal region between the first and second mandibular molars so that probing angulation during surgery was identical in all patients. The insertion path of the probe was created as a groove using fissure burs so that all measurements were performed in a repeatable path. After injecting the anesthetic and placing the stent in the region, the distance between the CEJ of the teeth and alveolar bone margin was measured by a periodontist using a Williams probe. After flap reflection and granulation tissue removal, the acrylic stent was placed once again, and the distance between the CEJ and the most apical part of the bony defect was measured using a Williams probe. If the CEJ was destructed by caries or restorations the apical and of caries or restoration

was used for measurement. On the panoramic the linear distance between the CEJ and BD (the most apical point of the alveolar crest which crosses the root surface) was measured by an oral radiologic using a digital caliper (Nippon) with an accuracy of 0.01 mm. The distance was also measured by the Digital Ruler of the panoramic device in millimeters in this method the landmarks were determined on the radiograph, and their distance was measured by the software. The data were analyzed using SPSS version 21 (Spss Inc, Chicago, IL, USA). In this study, measurement during surgery was considered as the gold standard and independent-samples *t*-test was used to compare with the other methods. The correlation between the surgical technique and the other techniques was evaluated using the Pearson's correlation coefficient. The significance was set at 0.05 in all tests.

RESULTS

The mean values of the defect depths measured through bone probing and radiographic technique were less than the surgical technique [Figure 1]. The results of the independent-samples *t*-test are shown in Table 1. The mean depth of the vertical alveolar bone defects in probing under anesthesia and surgery was respectively 43.5 ± 60.1 and 60.5 ± 59.1 mm but the difference was not statistically significant ($P = 0.377$). The mean values of vertical alveolar bone resorption on panoramic using a Digital Caliper and Digital Ruler were respectively 19.4 ± 63.1 and 46.4 ± 57.1 mm which both were significantly different from the surgical method ($P < 0.001$). The difference between the Digital Caliper and Digital Ruler was not significant according to the independent samples *t*-test ($P = 0.152$). There was a high correlation between the values of vertical bone resorption measured through surgical and under anesthesia probing ($r = 0.98$, $P < 0.001$). There was also a high correlation between the values measured through surgical and Digital Ruler methods ($r = 0.89$, $P < 0.001$). This correlation was lower between the surgical and the Digital Caliper methods ($r = 0.79$, $P < 0.001$).

DISCUSSION

Periodontal disease is a common ailment which is characterized by inflammation and destruction of periodontal tissues.^[1] The form and amount of bone

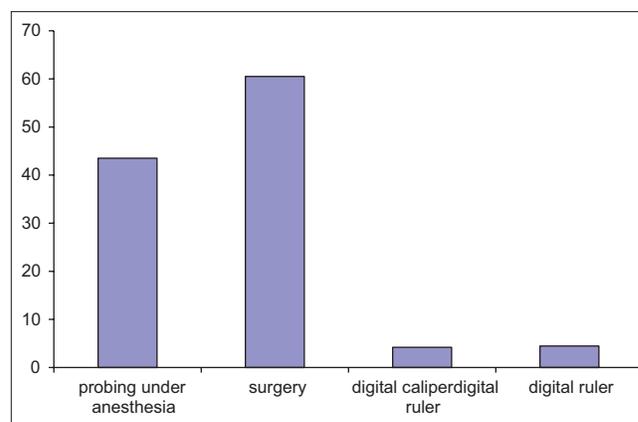


Figure 1: Comparison of mean alveolar bone defect measurements by four techniques.

Table 1: The comparison of mean and standard deviations of alveolar bone defects measured by surgical, probing under anesthesia, and panoramic radiograph

Alveolar bone defects	Mean±SD	Mean Difference	P
Probing under anesthesia	43.5±60.1	-0.17	0.377
Surgery	60.5±59.1		
Digital Caliper	19.4±63.1	-1.41	0.001
Surgery	60.5±59.1		
Digital Ruler	46.4±57.1	-1.41	0.001
Surgery	60.5±59.1		

SD: Standard deviation

resorption not only affects the treatment planning but also the prognosis and treatment response.^[6] To describe the amount of periodontal destruction the clinician has to rely on the information obtained from clinical examination and radiographs.^[13]

In the present study, we compared the amounts of bony defect depths measured by probing under anesthesia, digital panoramic with direct surgical measurement in sixty patients with ninety vertical alveolar bony defects. The mean value of the differences between probing and surgical methods was 0.17 mm which was not statistically significant ($P = 0.377$). This result is similar to other studies.^[14-17] In the study of Abolfazli *et al.*^[14] this difference was 0.27 mm which was only significant in defects with two walls. Savitha *et al.*^[15] reported a 0.25 ± 0.02 mm difference between the two methods which was not significant ($P = 0.846$).

Our results showed a high correlation between bone probing and surgery ($r = 0.98$, $P < 0.001$) which was similar to other studies. Ursell^[8] reported a 0.975 correlation and thus concluded that transgingival probing is an accurate method for evaluating the level

of alveolar bone. Savitha *etal.*^[15] reported a 0.97 correlation. While Abolfazli *etal.*^[14] reported a 0.9 correlation. Bone probing has similar Results with the gold standard (measuring during surgery) and has a strong correlation with it therefore bone probing can be used instead of the surgical method.

In this study, measuring the depth of the defects on panoramic radiographs using a Digital Ruler and a Digital Caliper underestimated the depths compared with the gold standard. Other studies have also shown that intraoral and panoramic radiographs underestimate bone resorption compared to the surgical method.^[16] Akesson *etal.*^[17] reported that all radiographic methods underestimate bone resorption.

Sairamand Gagan^[18] compared probing pocket depth with bitewing and panoramic radiographs for measuring bone level and reported that both radiographic methods underestimate bone levels. Gedik *et al* measured the distance between the cemento-enamel junction and crest of alveolar bone, they then compared it with bone levels measured by bite-wing, periapical and panoramic radiographs. They stated that all radiographic methods underestimate bone levels. Measurement during surgery was used as the gold standard in this study because it is the most accurate method for evaluating bone defects. Our results also showed that panoramic method underestimates bone resorption. Chitsazi *et al.*^[19] also showed that periapical, bitewing and panoramic radiographs all underestimate bone levels compared to surgery. Contradictory to our results, Pepelassi *et al.*^[20] reported that periapical and panoramic radiographs overestimate the depth of the defects compared to the surgical method.

Kiliç *et al.*^[21] also reported that radiographs overestimate bony defect depths but underestimate the depth of the lesions with furcation involvement.

According to radiologic references, panoramics are not suitable for evaluating periodontal disease because they underestimate mild marginal bone destructions and overestimate extensive destructions. Panoramic radiographs are less clear and have a lower resolution compared to intra-oral radiographs, and small defects do not produce a visible density on radiographs and also the superimposition of higher bone walls can lead to the underestimation of small defects in panoramic radiographs.^[4] Exposure conditions, density, and contrast of the image can affect the proper diagnosis of alveolar bone levels. An important fact that must be

considered is that to evaluate periodontal conditions the films should be less exposed so that the thin alveolar crest will not be burned out. High exposure and contrast lead to the burning out of crestal edges and overestimation of extensive destructions is the result.^[4] In this study, panoramic images underestimated the destruction compared to surgery which is similar to most studies. The difference between our results and previous studies could be due to several variables such as exposure conditions, density and contrast of the image, the type of defect (even or vertical), depth and width of angular defects, superimposition of buccal, and lingual cortical plates which hides the defect, quality of panoramic device, type of the device (digital computed radiography [CR] digital radiography [DR] or conventional). The type of the tooth involved in the lesion and uneven magnification of panoramic images. In this study, we used the digital CR device which has a different quality compared to the DR device which can affect the results. Linear measurements are unreliable in panoramic images because the amount of distortion and magnification are different even in various parts of a single image. Thus, panoramic data should be interpreted with caution.

In this study, the highest correlation with the surgical method belonged to bone probing followed by Digital Ruler on the panoramic image and the least correlation belonged to measuring using a Digital Caliper on the panoramic. It should be mentioned that the difference between the Digital Ruler and Digital Caliper was not significant ($P = 0.125$) it should be mentioned that the Digital Ruler is a software of the panoramic device therefore it is more accurate than the Caliper. Furthermore, positioning of the Caliper can affect the measurement.

CONCLUSION

Based on the present study, bone probing is a reliable method in vertical alveolar bone defect measurements. While the information obtained from digital panoramic radiographs should be used with caution and the ability of digital panoramic radiography in the determination of defect depth is limited.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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