

## The Effect of X-Ray Vertical Angulation on Radiographic Assessment of Alveolar Bone Loss

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### ABSTRACT

**Introduction:** Radiographs provide unique information about the status of periodontium and permanent records of condition of bone throughout the course of the disease. Interproximal images record the distance between the Cementoenamel Junction and the crest of the interradicular alveolar bone, more accurately. The aim of this study was to investigate the effect of different vertical angles of x-ray tube (0, -10, +10) degrees in horizontal and vertical bite wing techniques in assessment of bone loss.

**Methods:** One hundred and twenty bitewing radiographs from 150 interproximal surfaces from 10 dried skull were by three degrees (0, -10, +10) prepared. The level of alveolar bone loss was measured using ruler on the skulls and radiographs and data were registered. Type of bone loss was horizontal.

**Results:** The maximum differences between invitro and radiographic findings were +3 and -2.745 mm. In all areas, radiographic data were less than clinical diameters. In all areas, by using zero degree vertical angulation, there was less difference between mean of radiographics and clinical measurements.

**Conclusions:** with changing vertical angulations, using 0, +10, and -10 degrees, a wide range of measures (2.75-3mm) in amount of alveolar bone loss were obtained for evaluating periodontal disease or following them up, accurate and reproducible images are necessary. In this study we concluded that zero vertical angulation degree decrease the angulation errors and reduce underestimation of radiographic assessment of alveolar bone loss.

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### Introduction

Along with marginal inflammation, periodontal pocket formation, and attachment loss, are primary features of periodontitis. The height of alveolar bone may be evaluated by intrasurgical inspection or by radiographic examination. However radiographic assessment tends to underestimate the amount of bone loss<sup>1,2</sup>. Projection geometry of serial radiographs should be standardized to minimize measurement errors<sup>3,4</sup>. Such errors are often

difficult to be distinguished from biologic changes<sup>5</sup>.

Advanced radiographic analysis by measurement of linear distance or digital subtraction require highly standardized projection. Whereas digital subtraction analysis can be used only to assess differences between at least two radiographs, linear measurements can be used to assess bone status on single radiographs<sup>6,7</sup>. However, even in single radiographs, projection geometry may influence validity of interpretation<sup>8,9</sup>.

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The clinical evaluation and assessment of a patients' periodontal status requires that information be collected from several diagnostic tests and then assimilated into a diagnostic impression. One commonly used diagnostic procedure is the radiographic examination, which not only offers information about the patients' present condition but also affords a practitioner the ability for longitudinal assessment of changes or stability within the supporting periodontium.

This matter of fact that radiographs may be useful to detect minute changes within the alveolar bone, has led to studies on radiographic techniques such as subtraction radiography and radiometric analysis, however, most practitioners still depend heavily on routine intraoral radiographic techniques for periodontal assessment<sup>10</sup>.

To optimize diagnostic information from routine radiographic examination, appropriate radiograph of the highest quality should be used. Radiographs play an integral role in assessment periodontal disease. They provide unique information about the status of periodontium and permanent records of condition of bone throughout the course of the disease. Interproximal cemento enamel images record the distance between the junction (CEF) and the crest of the interradiolar alveolar bone, more accurately.

The aim of this study was to assess the validity of linear measurement of alveolar bone loss on horizontal and vertical bitewing radiographs by using three vertical angles (0, -10, and +10) by real measurement on skull

### Materials and Methods

At first, 10 dried skull were prepared from Anatomy Department of Medicine University of Isfahan, Iran. The acceptance conditions of skulls were existing teeth and alveolar bone resorption.

The resorption of alveolar crests were measured mesially and distally by exact ruler by 1% accuracy. For each area, every

place was measured three times and their means were registered.

We concluded the distance between CEJ and alveolar crest type of bone loss was horizontal and we concluded the mean bone loss of buccal and lingual plate.

Skulls were stabilized so that their sagittal plans were at right angle to horizontal plans and occlusal plans were parallel to horizontal plans. For preparing horizontal and vertical bitewing, we used AGFA, periapical, E speed, size 2 films.

120 vertical and horizontal Bite wings radiography were prepared by three vertical angles (0, +10, -10 degrees). Skulls were stabilized so that their conditions did not move after each radiography. For each radiograph, mA and kVp were the same. For preparing soft tissue equivalent, we used 6mm of wax. We used trophy x-ray unit and films were processed by peri - pero automatic processor.

150 areas with periodontal lesions, were survived in posterior teeth.

Radiographs were viewed by view box. The distance between CEJ and alveolar crest were measured mesially and distally using an exact ruler and data were registered. Statistical analysis was done using t-student test.

### Results

In this study, we compared amounts of alveolar bone loss in vitro and in bite wing radiography, using three angles (0, -10, +10) in 150 teeth surfaces. Data are shown in tables 1 and 2:

**Table 1: Different means among 3 groups by three angles (0, -10, +10), in teeth of maxilla.**

Group	Mean	SD	T	DF	P
+10 angle	0.3521	0.9442	-1.116	47	0.270
-10 angle	0.5625	0.8780	6.017	47	0.000
0 angle	0.125	0.4684	1.109	47	0.273

SD: standard deviation.

**Table 2: Different means among 3 groups by three angles (0, -10, +10) in teeth of mandible.**

Group	Mean	SD	T	DF	P
+10 angle	0.5376	0.8572	5.873	84	0.000
-10 angle	0.1376	1.0027	1.226	84	0.209
0 angle	0.09	0.7049	1.169	84	0.246

SD: standard deviation.

### Conclusion

one of the methods of periodontal disease diagnosis is radiography, by which the level of alveolar bone resorption can be measured in per apical radiography. Multi factors are effective on determining the amount of alveolar bone loss such as the angle of central x- ray, type of film, processing, and the skills of clinician.

One of the most useful techniques in evaluation of periodontal disease is bite wing technique<sup>10</sup>. The vertical angle of bitewing radiography effects on estimating of alveolar bone loss.

In this study we used three vertical angles (0, -10, +10).

In maxilla, by using zero vertical angle, there was a little difference between real alveolar bone loss and radiographic measurement (p-value=0.237). In

Mandible, by using zero vertical angle, there was no difference between real alveolar bone loss and radiographic measurements.

SM Jenkins concluded that 0 to 20 degrees vertical angulations caused decrease in distance between crest and CEJ<sup>11</sup>. Schei concluded that changinges 10 degrees in vertical angulations in anterior teeth, had less effect on measurement of alveolar bone loss than posterior teeth<sup>12</sup>.

Khalid Almas concluded in their research that changing vertical angulations from -10 to +10 will change the amount of alveolar bone loss from 1. 84 to 3.70 millimeters<sup>13</sup>.

Amin Tavakoli and Mehdizaden concluded in their study about the effectiveness of parallel and bitewing Radiographies, using XCp in measuring alveolar bone loss, that vertical bitewing was more accurate<sup>14</sup>.

Alveolar bone loss, attributable to periodontitis, can be assessed using intra oral radiographs, however these radiographs provide only two dimensional structures. Changes in the projection geometry between consecutively obtained radiographs may lead to different two – dimensional images of the same three – dimensional situation.

Such artifacts often are difficult to be distinguished from pathologic changes. Hence, the projection geometry of serial radiographs has to be highly standardized. Projection artifacts may be caused by different angulations between the central beam and film while the relationship between teeth and film is fixed<sup>15</sup>.

In this research, we conclude that by using zero degree vertical angulation, we had less difference between radiographic and real measurements of alveolar bone loss. Also by using +10 vertical angulation for Maxilla and -10 degree for Mandible we had less different by real measurements by changing vertical angulations. We have changes in measuring alveolar bone loss and this phenomena cause false conclusion. Radiography is not effective lonely and we need use use other methods such as probing and...

By using film holders, we decrease the alignment errors, and vertical bitewing by

zero vertical angulation seem to be suitable.

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