A Survey on the Accuracy of Radiovisiography in the Assessment of Interproximal Intrabony Defects

A.R. Talaiepour¹,², M. Panjnoush³, Y. Soleimanishayeste⁴, F. Abesi⁵, S. Sahba⁶

¹Associate Professor, Dental Research Centre, Tehran University of Medical Sciences, Tehran, Iran
²Associate Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
³Assistant Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
⁴Assistant Professor, Department of Periodontology, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
⁵Oral and Maxillofacial Radiologist, Private practice
⁶Assistant Professor, Department of Oral Medicine, Faculty of Dentistry, Shaheed Beheshti University of Medical Sciences, Tehran, Iran

Abstract:
Statement of problem: Digital measurement of RVG may improve diagnostic interpretation of radiographs in terms of accuracy, although it has been shown that validity of linear measurements of interproximal bone loss could not be improved by basic digital manipulations.

Purpose: The aim of this study was to evaluate the accuracy of RadioVisioGraphy (RVG) in the linear measurement of interproximal bone loss in intrabony defects.

Materials and Methods: Thirty two radiographs of 56 periodontally diseased teeth exhibiting interproximal intrabony defects were obtained by a standardized RVG technique and Intrabony defect depths were determined by linear measurement analysis of RVG. The following four distances were assessed intrasurgically: the cemento-enamel junction (CEJ) to the alveolar crest, the CEJ to the deepest extension of the bony defect (BD), the occlusal plane to the BD and the OP to the AC. Comparison between RVG measures and intrasurgical estimates were performed using paired t-test.

Results: The radiographic measurements overestimated interproximal bone loss as compared to the intrasurgical measurem ents: CEJ-BD measurement by RVG was 6.803 ± 3.589 mm and intra-surgically was 6.492 ± 3.492 (P<0.000). No statistically significant difference was seen between CEJ and occlusal references in RVG measurements (P<0.729).

Conclusion: Radiographic assessment by either the CEJ or occlusal references overestimated bone loss as compared to the intrasurgical gold standard.

Key Words: Direct digital radiography (RVG); Intrabony defect; Periodontal disease

INTRODUCTION

Alveolar bone loss is the main feature of destructive inflammatory periodontal disease. The height of the alveolar bone may be evaluated by radiographic examination. However, conventional radiographic assessment tends to underestimate the amount of bone loss. On the other hand in 2001 Wolf et al stated that the average of digital radiographic measurements tended to overestimate the amount of bone loss compare to intrasurgical measurements. Digital measure-
ment of RVG may improve diagnostic interpretation of radiographs in terms of accuracy, although it has been shown that validity of linear measurements of interproximal bone loss could not be improved by basic digital manipulations [1,2,3]. The aim of the present study was to assess the accuracy of linear measurements of interproximal bone loss in intrabony defects on RVG images by using intrasurgical measurements as a gold standard [4,5].

MATERIALS AND METHODS
Thirty two RVG radiographs, which displayed 56 interproximal sites (14 second premolars distal; 14 first molars mesial and 14 first molars distal aspects, 14 second molar mesial), were obtained from 7 patients suffering from moderate to advanced untreated periodontal disease. All patients were scheduled for periodontal treatment in the Department of Periodontology, Faculty of Dentistry, Tehran University of Medical Sciences. Risk and benefits of diagnostic and therapeutical procedures were explained to the patients and written consents were obtained.

Radiographic Examination: After completion of initial periodontal treatment including oral hygiene instruction and scaling, standardized parallel direct digital images (RVG-Trophy 5th generation/France) were taken of teeth exhibiting vertical intrabony defects or horizontal interproximal bone loss. Intrabony defect depths were determined by linear measurement analysis of RVG. The following four distances were assessed by RVG for each defect: CEJ to AC, CEJ to BD, OP to BD and OP to AC. Therefore 224 digital measures were obtained.

To estimate magnification and also to obtain an occlusal reference, an orthodontic wire with known diameter and length was fixed on the occlusal surface by red dental wax (Fig. 1 A and B). The cemento-enamel junction (CEJ), alveolar crest (AC) and bony defect (BD) were used as landmarks.

Biometric Evaluation: To estimate the validity of RVG measurements, the distances measured on the pre-surgical radiographs were compared to the intra-surgical assessments as the gold standard. For all defects, two intrasurgical assessments were performed at the interproximal defects and distances from CEJ to AC, CEJ to BD and occlusal plane (OC) to AC and OC to BD were measured by a clipper.

Statistical analysis: Paired t-test and Wilcoxon was used for comparing the measurements obtained by RVG and surgery.

RESULTS
The mean of pocket depth measurements, and the results obtained from statistical analysis including standard deviation, correlation coefficient, and P-value are shown in Table I. The mean bone loss measured by the radiographic method among 224 was 6.8±3.58 mm whereas in the intra-surgical method was 6.49±3.46mm. The difference between surgical and RVG bone loss was 0.31±0.43mm with a 0.99 correlation coefficient.

As shown in Table-I, mean bony pocket depth measurement in the radiographic method using the occlusal reference was 9.72±2.12mm and by intra-surgical measurement was 9.38±2.02mm. The difference between the
means was 0.34 ± 0.44mm and their correlation coefficient was 0.94.
In the radiographic technique utilizing the CEJ reference, mean bone loss was 3.9 ± 1.87mm and that of the surgical technique was 3.58 ± 1.75mm. The difference between the two means was found to be 0.32 ± 0.44mm and their correlation coefficient was 0.964.

**DISCUSSION**
Periodontal alveolar bone loss can be assessed using intra-oral radiographs. However, these radiographs provide only two dimensional images of three-dimensional structures. Although the projection geometry of serial radiographs has to be highly standardized [1,8], radiographs underestimate the extent of alveolar bone loss as compared to the gold standard of intrasurgical measurements in many studies [1,6,9-14].
Digital imaging may enhance diagnostic interpretation of radiographs. However, the present study revealed that digital radiographs overestimated the amount of bone loss up to 0.31 ± 0.51mm.
These findings confirm the observation of Adosh et al and Wolf et al [1,15]. They stated that the amount of bone loss assessed by digital radiographs tended to overestimate compare to the intrasurgical measurements. However, in the present study, when considering the CEJ reference, radiographic measurements were estimated closer to the intrasurgical gold standard although a statistically significant difference was not observed.
In this study, a new reference called the occlusal plane was introduced, which in comparison to the CEJ, is more accessible, more conspicuous, better achievable and more accurate measurement reference. However, no statistically significant difference was found

---

**Table I: A comparison on mean bone loss between radiography and surgery measurements**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean</th>
<th>Number</th>
<th>Standard deviation</th>
<th>Mean error of measurement</th>
<th>Correlation coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography</td>
<td>6.803</td>
<td>224</td>
<td>3.589</td>
<td>0.240</td>
<td>0.99</td>
<td>0.000</td>
</tr>
<tr>
<td>Surgery</td>
<td>6.492</td>
<td>224</td>
<td>3.462</td>
<td>0.231</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiography on mesial aspect</td>
<td>6.761</td>
<td>112</td>
<td>3.722</td>
<td>0.351</td>
<td>0.991</td>
<td>0.000</td>
</tr>
<tr>
<td>Surgery on mesial aspect</td>
<td>6.434</td>
<td>112</td>
<td>3.615</td>
<td>0.341</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiography on distal site</td>
<td>6.845</td>
<td>112</td>
<td>3.466</td>
<td>0.328</td>
<td>0.989</td>
<td>0.000</td>
</tr>
<tr>
<td>Surgery on distal site</td>
<td>6.550</td>
<td>112</td>
<td>3.318</td>
<td>0.313</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiography with occlusal reference</td>
<td>9.728</td>
<td>112</td>
<td>2.122</td>
<td>0.201</td>
<td>0.944</td>
<td>0.000</td>
</tr>
<tr>
<td>Surgery with occlusal reference</td>
<td>9.389</td>
<td>112</td>
<td>2.029</td>
<td>0.192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiography with CEJ reference</td>
<td>3.904</td>
<td>112</td>
<td>1.879</td>
<td>0.178</td>
<td>0.964</td>
<td>0.000</td>
</tr>
<tr>
<td>Surgery with CEJ reference</td>
<td>3.587</td>
<td>112</td>
<td>1.755</td>
<td>0.166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiography and Surgery with occlusal reference</td>
<td>0.338</td>
<td>112</td>
<td>0.7009</td>
<td>6.623 E-02</td>
<td>0.499</td>
<td>0.729</td>
</tr>
<tr>
<td>Radiography and Surgery with CEJ reference</td>
<td>0.317</td>
<td>112</td>
<td>0.5021</td>
<td>4.744 E-02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
between the CEJ and occlusal references (P<0.729).

CONCLUSION:
Radiographic assessment by either the CEJ or occlusal references overestimated bone loss when compared to the intrasurgical gold standard.

REFERENCES
بررسی دفت رادیوئیزوگرافی در ارزیابی ضایعات داخل استخوانی
بين دندانی

چکیده

目的: حضور محاسبه ای با هدف بررسی دقت رادیوئیزوگرافی (RVG) در ارزیابی خطي ابعاد استخوان بین دندانی در ضایعات داخل استخوانی انیتربیوسکمال تهیه شد و عمل ضایعات داخل استخوانی با استفاده از آنالیز خطی برپا خواهند شد. CEJ با استفاده از CEJ به عنوان تایید حاضر، این تایید را برتر از آنروده با استفاده از CEJ در ارزیابی داخل استخوانی محاسبه می‌گردد.

روش تحقیق: تعداد 32 دندان استخوانی به روش استخوانی RVG و روش استخوانی انیتربیوسکمال، به همراه 65 دندان مبتلا به بیماری پروپنتوئال و دارای ضایعات استخوانی

واژه کلیدی: رادیوئیزوگرافی دیدیت استخوانی (RVG)؛ ضایعات داخل استخوانی؛ بیماری پروپنتوئال

1. نوبنده سرور: دانشیار، دانشگاه علوم پزشکی تهران، تهران، ایران
2. دانشجو آموزشی رادیوئیزوگرافی دندانی، دانشگاه علوم پزشکی تهران، تهران، ایران
3. استاد رادیوئیزوگرافی دندانی، دانشگاه علوم پزشکی تهران، تهران، ایران
4. استاد رادیوئیزوگرافی دندانی، دانشگاه علوم پزشکی تهران، تهران، ایران
5. استاد رادیوئیزوگرافی دندانی، دانشگاه علوم پزشکی تهران، تهران، ایران
6. دانشجو آموزشی بیماری پروپنتوئال، دانشگاه علوم پزشکی تهران، تهران، ایران

ارادی، پژوهش‌نامه 3، سیمینار شایسته 4، عاسبی 5، سه‌گانه 6.