

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

A.R. Talaiepour^{1,2}, 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

⁴Associate 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 measurements: 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

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✉ Corresponding author:

A.R. Talaiepour, Department of Oral and Maxillofacial Radiology, Tehran University of medical sciences, Gods St., Keshavarz Bulv., Post Code: 14147, Tehran, Iran.
ar_talai@yahoo.com

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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 assess-

ment 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

Salonen et al [6] and Benn et al [7].

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.

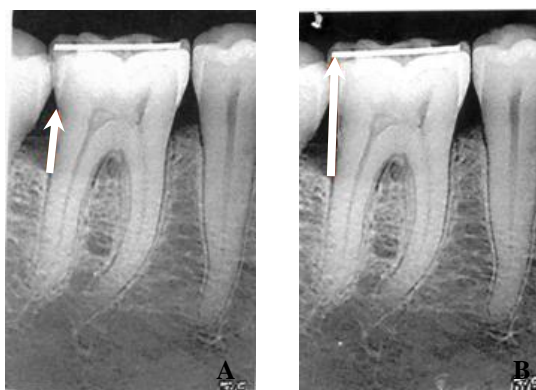


Fig. 1: A; Using CEJ and B; Using occlusal reference to determine the distance from alveolar crest (AC) and bony defect (BD)

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 ± 3.46 mm. The difference between surgical and RVG bone loss was 0.31 ± 0.43 mm 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 ± 2.12 mm and by intra-surgical measurement was 9.38 ± 2.02 mm. The difference between the

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

Sample	Mean	Number	Standard deviation	Mean error of measurement	Correlation coefficient	P-value
Radiography	6.803	224	3.589	0.240	0.99	0.000
Surgery	6.492	224	3.462	0.231		
Radiography on mesial aspect	6.761	112	3.722	0.351	0.991	0.000
Surgery on mesial aspect	6.434	112	3.615	0.341		
Radiography on distal site	6.845	112	3.466	0.328	0.989	0.000
Surgery on distal site	6.550	112	3.318	0.313		
Radiography with occlusal reference	9.728	112	2.122	0.201	0.944	0.000
Surgery with occlusal reference	9.389	112	2.029	0.192		
Radiography with CEJ reference	3.904	112	1.879	0.178	0.964	0.000
Surgery with CEJ reference	3.587	112	1.755	0.166		
Radiography and Surgery with occlusal reference	0.338	112	0.7009	6.623 E ^{-0.2}	0.499	0.729
Radiography and Surgery with CEJ reference	0.317	112	0.5021	4.744 E ^{-0.2}		

means was 0.34 ± 0.44 mm and their correlation coefficient was 0.94.

In the radiographic technique utilizing the CEJ reference, mean bone loss was 3.9 ± 1.87 mm and that of the surgical technique was 3.58 ± 1.75 mm. The difference between the two means was found to be 0.32 ± 0.44 mm 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 ± 0.51 mm.

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

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.

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بررسی دقت رادیوویزیوگرافی در ارزیابی ضایعات داخل استخوانی بین دندان‌ها

۱. ر. طلایی پور^۱ - م. پنج‌نوش^۳ - ی. سلیمانی شایسته^۴ - ف. عابسی^۵ - س. صهبای^۶

^۱ نویسنده مسؤل؛ دانشیار مرکز تحقیقات دندانپزشکی، دانشگاه علوم پزشکی تهران، تهران، ایران
^۲ دانشیار گروه آموزشی رادیولوژی دهان و فک و صورت، دانشکده دندانپزشکی، دانشگاه علوم پزشکی تهران، تهران، ایران
^۳ استادیار گروه آموزشی رادیولوژی دهان و فک و صورت، دانشکده دندانپزشکی، دانشگاه علوم پزشکی تهران، تهران، ایران
^۴ استادیار گروه پریودنتیکس، دانشکده دندانپزشکی، دانشگاه علوم پزشکی تهران، تهران، ایران
^۵ متخصص رادیولوژی دهان و فک صورت
^۶ دانشیار گروه آموزشی بیماریهای دهان، دانشکده دندانپزشکی، دانشگاه علوم پزشکی شهید بهشتی، تهران، ایران

چکیده

بیان مسأله: استفاده از اندازه‌گیری دیجیتال رادیوویزیوگرافی (RVG)، می‌تواند سبب پیشرفت تفسیرهای رادیوگرافیک گردد؛ البته نشان داده شده که اعتبار اندازه‌گیریهای خطی استخوان را نمی‌توان با به کار بردن دستگاههای دیجیتال بهبود بخشید.
هدف: مطالعه حاضر با هدف بررسی دقت رادیوویزیوگرافی (RVG) در اندازه‌گیری خطی ابعاد تحلیل استخوان بین دندان‌ها در ضایعات داخل استخوانی انجام شد.

روش تحقیق: تعداد ۳۲ رادیوگرافی به روش استاندارد RVG، از ۵۶ دندان مبتلا به بیماری پریودنتال و دارای ضایعات استخوانی اینترپروکسیمال، تهیه شد و عمق ضایعات داخل استخوانی با استفاده از آنالیز خطی RVG محاسبه گشت؛ همچنین در حین جراحی پریودنتال نیز چهار فاصله خطی CEJ تا کرسست استخوان آلوئول، CEJ تا عمیق‌ترین ناحیه ضایعه (BD)، پلن اکلوزال تا BD و پلن اکلوزال تا کرسست استخوان آلوئول اندازه‌گیری شد. اندازه‌های RVG و اندازه‌های به دست آمده در حین جراحی با استفاده از آزمون t نمونه‌های زوجی مقایسه شدند.

یافته‌ها: رادیوگرافی، اندازه ضایعات را بزرگتر از واقعیت جراحی نشان داد. فاصله CEJ تا BD در RVG برابر $۶/۸۰۳ \pm ۳/۵۸۹$ میلی‌متر و در جراحی $۴/۴۹۲ \pm ۳/۴۹۲$ میلی‌متر بود ($P < ۰/۰۰۱$). هیچ‌گونه اختلاف آماری معنی‌داری بین CEJ و مراجع اکلوزال در RVG مشاهده نشد ($P = ۰/۷۲۹$).

نتیجه‌گیری: RVG، میزان از دست رفتن استخوان را با استفاده از هر دو مرجع CEJ و اکلوزال، بزرگتر از اندازه به دست آمده از استاندارد طلایی (gold standard) (برآورد اندازه حین جراحی) گزارش می‌نماید.

واژه‌های کلیدی: رادیوگرافی دیجیتال مستقیم (RVG)؛ ضایعات داخل استخوانی؛ بیماری پریودنتال

مجله دندانپزشکی دانشگاه علوم پزشکی و خدمات بهداشتی، درمانی تهران (دوره ۲، شماره ۱، سال ۱۳۸۴)