Assessment of Alveolar Bone Levels from Bitewing, Periapical and Panoramic Radiographs in Periodontitis Patients

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ABSTRACT

The aim of this study was to determine the relationship between loss of radiographic crestal bone height in panoramic, bitewing and periapical radiography and to probe the attachment loss after periodontal treatment. Radiographic and probing measurements were made at baseline and after one year. The population in the study consisted of 21 individuals, 13 females and 8 males, ages 18–59 [mean 35.7] years. A total of 42 interproximal intra-bony defects of 21 mandibular first molar teeth, treatments of which were planned by subgingival curettage procedures, were selected from among 21 subjects who had signed consent forms. Measurements of the distance between the cemento-enamel junction and the alveolar crest were compared with probing crestal bone level and radiographic measurements before and one year after the procedures. The results of probing pocket depths level before and one year after subgingival curettage were different with the mean average being 1.18 ± 1.51 mm. These changes were statistically significant ($p < 0.05$*). Bitewing radiography showed the highest accuracy among radiographic methods in the assessment of the crestal bone level mean average 0.22 ± 0.87 mm (*$p < 0.05$*). There was only a slight mean difference compared to panoramic radiography but this was statistically insignificant, mean average 0.20 ± 1.35 mm (*$p > 0.05$*), and the periapical radiography had the lowest accuracy of radiographic methods, changed mean average -0.14 ± 1.19.mm (*$p > 0.05$*).*

In summary, we can say that both bitewing and panoramic radiography are preferred to periapical images for crestal bone assesment.

Evaluación de los Niveles de Hueso Alveolar a Partir de Radiografías Interproximales, Periapicales y Panorámicas en Pacientes con Periodontitis

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RESUMEN

El objetivo de este estudio fue determinar la relación entre la pérdida de altura radiográfica de hueso crestal en radiografías panorámicas interproximales y periapicales, e investigar la pérdida de inserción tras el tratamiento periodontal. Las mediciones radiográficas y de sondeo fueron realizadas en la situación inicial y luego de un año. La población bajo estudio consistió en 21 individuos, 13 hembras y 8 varones, con edades 18–59 [media 35.7] (años). Un total de 42 defectos intraóseos interproximales de 21 primeros molares mandibulares, cuyos tratamientos fueron planeados mediante procedimientos de curetaje subgingival, fueron seleccionados de entre 21 sujetos que habían firmado su consentimiento. Las mediciones de la distancia entre la unión cemento-esmalte y la cresta alveolar, fueron comparadas sondeando el nivel de hueso crestal y recurriendo a mediciones radiográficas, antes y después (un año más tarde) de los procedimientos. Los resultados del sondeo del nivel de profundidad

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de la bolsa antes y después del curetaje subgingival, fueron diferentes, siendo la media promedio 1.18 ± 1.51 mm. Estos cambios fueron estadísticamente significativos (p < 0.05). La radiografía interproximal mostró la mayor exactitud entre los métodos radiográficos de evaluación del nivel óseo crestal, para una media promedio de 0.22 ± 0.87 mm (p < 0.05). Hubo sólo una ligera diferencia media en comparación con la radiografía panorámica, pero fue estadísticamente insignificante, siendo la media promedio 0.20 ± 1.35 mm (p > 0.05). En cambio, la radiografía periapical resultó ser la de más baja precisión entre los métodos radiográficos, para un cambio en la media promedio de -0.14 ± 1.19.mm (p > 0.05). En resumen, puede decirse que tanto la radiografía interproximal como la panorámica tienen preferencia por sobre las imágenes periapicales a la hora de la evaluación del hueso crestal.

INTRODUCTION

Radiographs have been used frequently in clinical and epidemiological studies to evaluate periodontal disease (1, 2). The aim of periodontal diagnostic procedures are to provide the clinician with unbiased information regarding the type, the severity and the location of periodontal disease. Based on the findings, the clinician is then able to formulate a treatment plan and thereafter assess and monitor the efficacy of the treatment rendered (3–7). The most widely used tools for the clinical diagnosis of periodontal disease and monitoring of outcome of care are the periodontal probe and intra-oral radiographs (8–10).

Periodontal probes are used to evaluate the severity of soft tissue inflammation, presence of plaque or calculus, pocket depths and attachment levels (10–12). Current probing methods are used but these methods are also subject to a multitude of errors. In consequence of their inherent inaccuracy, measurements of probing depths only represent an approximation of the actual depth of periodontal pockets and clinical attachment levels. On the other hand, radiographic methods provide information about hard tissue changes. Radiographic images are unable to reveal soft tissue changes including changes in periodontal attachment levels. Radiographic images compared over time indicate possible cumulative changes over a period of time. Radiographic assessments are also subject to multiple sources of error (12–16).

Despite the known limitation of periodontal probing and radiographic evaluation, the objectives of the present study were: (a) the assessment of the reliability of clinical and radiographic measurements of periodontal defects compared to baseline and attachment loss subgingival curettage procedures one year after initial probing, (b) the assessment of the possible association between selected clinical and radiographic measurements of bony interproximal defects, (c) the assessment of changes identified from probing to bone measurements that are assessed reliably by clinical and radiographic methods.

SUBJECTS AND METHODS

The population in the study consisted of 21 individuals: 13 females and 8 males, ages 18–59 (mean 35.7) years. A total of 42 interproximal intra-bony defects of 21 mandibular first molar teeth, treatments of which were planned for surgical subgingival curettage, were selected from among 21 subjects who had signed the consent forms. The measurements were made from two sites in a total of 21 patients. Radiographic measurements were made from 42 interproximal sites. Probing measurements were made from 120 sites. A series of one periapical, one bitewing and one panoramic radiograph was completed for each individual. All intra-oral radiographs were exposed using Kodak ultraspeed film, with exposure times of 3.5 seconds and with Sirona (Heliodent Vario, Germany) X-ray unit set at 70 Kvp and 7mAmp. All panoramic radiograph were taken with PM 2002 CC Proline (Planmeca OY, Helsinki, Finland) filtration 2.5 mm AIEquiv using Kodak T-MAT G/RA Dental Film (Eastman, Kodak, Rochester, NY, USA). All the exposed films were developed in an automatic film processor (Dürr, XR42-II, Bieligheim, Germany).

Prior to the subgingival curettage procedures, the crestal alveolar bone level for a specific tooth surface was defined as the distance along the tooth from the cemento-enamel junction to the alveolar crest. The distance from the cemento-enamel junction to the alveolar crest was measured using a millimetric compass (sensitivity 0.1 mm). In performing the actual measurements, all interproximal surfaces were first measured on the periapical radiographs, followed by measurement surfaces on bitewing and panoramic radiographs. Using periodontal probe, the clinical measurements were made and measured to the nearest probing depth, to identify the deepest interproximal defect site. A Williams probe of these measurements was repeated; gingival and plaque indices were also measured and recorded.

Surgical measurements were made following administration of local anaesthesia, subgingival curettage procedures and defect and root surface debridement.

All clinical measurements and procedures were performed by the same clinician. The same procedures were repeated (probing, radiographs, plaque and gingival indices) at 12 months after subgingival curettage procedures. Paired t-test was used to compare pairs of data from different measurements.

RESULTS

Comparisons between the three radiographic methods as well as the results of probing pocket depths level before and after subgingival curettage procedures are presented in Table1.

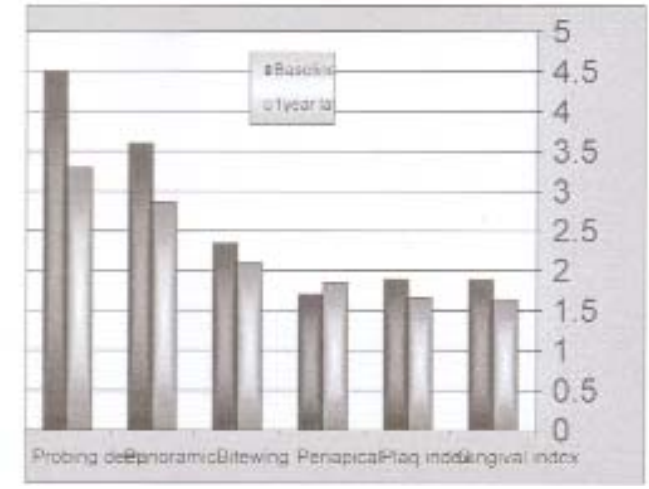

Fig. 1: Changes in radiographic and clinical measurements.

Probing was the most accurate method of assessing the pocket depths level. The depth average level was 4.48 ± 1.76 mm before subgingival curettage procedures which changed after subgingival curettage procedures (one year later) to 3.30 ± 0.96 mm, an average of 1.18 ± 1.51 mm. This change was statistically different ($p < 0.05$). Bitewing radiography which had the highest accuracy 2.34 ± 0.98 mm before surgery and 2.11 ± 1.06 mm after (an average 0.22 ± 0.87 mm, $p < 0.05$). Panoramic radiography had an accuracy of 3.06 ± 1.19 mm before surgery and 2.86 ± 0.96 mm after. This averaged 0.20 ± 1.35 mm but was statistically insignificant ($p > 0.05$). Periapical radiography using bisecting angle technique had the lowest accuracy of radiographic methods. Measurements were 1.71 ± 1.44 mm before subgingival curettage procedures and 1.85 ± 1.23 mm after (an average -0.14 ± 1.19 mm, $p > 0.05$). Also important changes were observed in the gingival index which was 1.90 ± 0.30 mm before subgingival curettage and 1.66 ± 0.47 mm after for an average of 0.26 ± 0.58 mm. No statistically significant changes were found in dental plaques index: 1.90 ± 0.48 mm before subgingival curettage procedures and 1.63 ± 0.49 mm after, with an average 0.23 ± 067 mm ($p > 0.059$).

DISCUSSION

The present study was designed to make comparisons between three radiographic methods and probing pocket depth levels before and after (one year later) subgingival curettage procedures. The radiographic examination and its limitations in periodontal diagnosis have been described in several review articles (3, 6, 9). According to these, radiographs of high quality only provide a general overview of periodontal breakdown. The only study where panoramic radiographs were compared with measurements of the same teeth after extraction showed a difference between the radiographic assessments and the tooth measurements of only 1.5–2%. The same relationship was obtained for intra-oral radiographs of the lower arch whereas the readings of intra-oral radiographs of the upper arch presented a difference of 2–3% (2).

In a clinical study, the accurancy of probing and radiographic measurements in assessing periodontal destruction was determined for patients requiring periodontal surgery. The difference between surgical and radiographic measurements using periapical radiography averaged 1.04 mm whereas the average difference between surgical and probing measurements was higher, 1.84 mm. On the other hand, in another study, the radiographic bone height was reported to have a lower degree of correlation with the bone height measured during surgery compared to the results of probing before surgery (8).

Periapical radiography had the lowest accuracy of the radiographic methods, changed mean average -0.14 ± 1.19 mm. But Akerson *et al* (13) reported that periapical radiography had a higher accuracy, as well as greater precision, compared to panoramic and bitewing radiography.

In the present study, important changes were observed in gingival indices before and after subgingival curettage, no statistically significant changes were found in dental plaque index.

In summary, we can say that the bitewing radiography is superior to periapical but there was only a slight difference compared to panoramic. Therefore, panoramic and bitewing would be preferable to periapical images for crestal bone assesment.

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