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Diagnostic Accuracy of Radiovisiography and Transperiodontal Probing with Intrasurgical Measurements for Assessment of Interproximal Bone Loss

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ABSTRACT

Aim: Compare diagnostic accuracy of radiovisiography and transperiodontal probing with intrasurgical measurements for assessment of interproximal bone loss.

Methods and Material: A total of 6 patients with 30 sample sites having proximal bone loss were included in the study. The RVG reading was recorded. A plugger with a stopper was used for probing and a digital calliper for measurement to achieve the accurate result. The patient was scheduled for flap surgery and after administering the local anaesthesia, the distance between stent and the deepest point on bone was recorded. For the third reading, flap was raised and the distance from stent to the bone was recorded by plugger was measured with the calliper.

Results: For the 30 samples mean value of defect depth is 12.65±1.64 mm for RVG which is lesser than both Intrasurgical (13.97±1.84) mm and trans periodontal probing (13.90±1.82) mm.

Conclusions: The results showed that in spite of using a grid and paralleling technique for taking RVG, the readings of trans periodontal probing were closest to the gold standard (Intrasurgical) measurements.

Keywords: RVG, Tansperiodontal probing, intra surgical, bole level, diagnostic accuracy.

INTRODUCTION

Diagnosis is the correct determination, discriminative estimation and logical appraisal of the conditions found during examination as evidenced by signs and symptoms of health and disease[1]. A complete and thorough examination includes both clinical and radiographic analysis. Although radiographic analysis acts as an adjunct to clinical findings; it conveys a hidden picture of the condition which remains unseen.[1]

Interproximal bone level assessment came into practice during diagnosis or monitoring the outcomes of regenerative treatment. To assess the bone level the gold standard method is re-entry to the site.[2] Currently, the most widely used tools for the clinical diagnosis of periodontal diseases and monitoring of outcome of care are the periodontal probe and intra-oral radiographs.[2] RVG has become widely accepted as an alternative to conventional radiography because of better image quality, less time and radiation exposure.[3]

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Bone sounding requires the insertion of a probe through the sulcus till the tip of the probe feels resistance against the crest of bone. In this method, a probe is placed vertically through the anesthetized gingiva down to the bone in order to assess the bone morphology.[4] While it is known that the gold standard of measuring remaining alveolar bone height is intrasurgical measurement, any technique that coincides with this measurement should be the choice of the clinician.[4]

In periodontal therapy, clinical and radiographic measurements are commonly used to assess treatment outcomes. The importance of accurate measurements is obvious and especially needed in clinical studies attempting at defining differences in efficacy between procedures and to correctly assess outcome of care when surgical reentry treatment is not a feasible option.[5]

So the aim of the study was to Compare diagnostic accuracy of radiovisiography and transperiodontal probing with intrasurgical measurements for assessment of interproximal bone loss

MATERIALS AND METHODS

Patients attending the Out Patient Department (OPD) of Periodontology were screened and enrolled in the study based on the inclusion and exclusion criteria. A total of 6 patients (30 sites with proximal bone loss) were selected. Each site was evaluated by R.V.G., transgingival probing and intrasurgical method for proximal bone loss assessment. The total sample size was 90.

Inclusion criteria were systemically healthy subjects above 18 years of age, patients with moderate to severe chronic periodontitis who were indicated for periodontal flap surgery and interproximal bone loss in the posterior teeth

Exclusion criteria were medically compromised patients, Pregnant & Lactating women, Subjects with history of taking antibiotics or NSAIDS in past 6 months. Subjects who had received any periodontal treatment in the past 6 months. Conditions that interfere with clinical and radiographic evaluation such as a. Patients undergoing orthodontic treatment b. Patients having extensive restorative work c. Patients with shallow palatal vault

For each subject a full-mouth periodontal probing and charting was done. OPG (Orthopantomogram) was taken for all the enrolled patients to confirm chronic periodontitis with bone loss.6 subjects with 30 sites who were scheduled to undergo flap surgery were included in the study. All subjects enrolled for study had signed a consent form to be a part of the study.

Fabrication of Stent: An alginate impression was made and a cast was poured with dental stone. A stent was fabricated with putty with a gutta percha embedded onto the occlusal surface on buccal aspect. A vertical groove was cut on the putty at each interdental area to allow easy insertion of plugger.(fig: 1)

Evaluation of radiographs for acceptable imaging was based on following criteria (Prichard J.F. 1961)[6]

- The radiograph should show the tips of molar cusps with little or none of occlusal surface shown
- Enamel caps and pulp chamber should be distinct
- Interproximal spaces should be open
- Proximal contact should not overlap unless teeth are out of line anatomically.

Transperiodontal probing (TP): For the measurement of bone probing depth by transperiodontal probing a plugger of number 40 with stopper was used. Bone probing depth was measured after administration of Local anesthesia. The measurement was taken from the fixed reference point (gutta percha point on stent) to the alveolar crest or to the deepest point encountered on the alveolar bone(fig:2)

Intrasurgical Method(IS): Surgical procedure: after administration of local anaesthesia incision was given and a full thickness flap was reflected. The debridement was done with the help of curretes and scalers. Then the stent was placed at the defect site and defect site was measured from the stent to the crest of the alveolar bone or to the deepest point along the line angle of the tooth with the help of a plugger of number 40 with stopper. (fig:3)

Measurement of defect depth: The plugger was then removed and measured against the digital

vernier caliper from the flat tip upto the stopper. (fig:4)

Fig 1: Fabrication of stent.

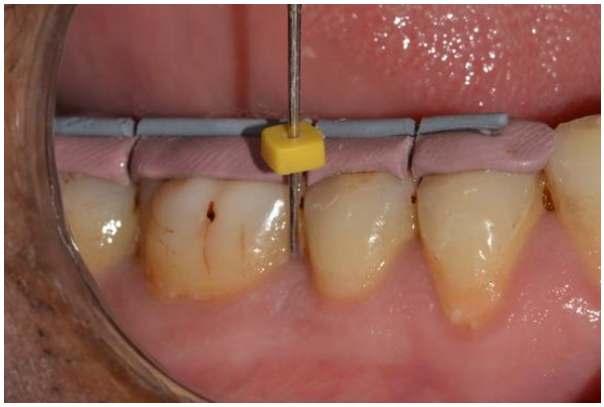


Fig 2: Transperiodontal probing using a plugger.

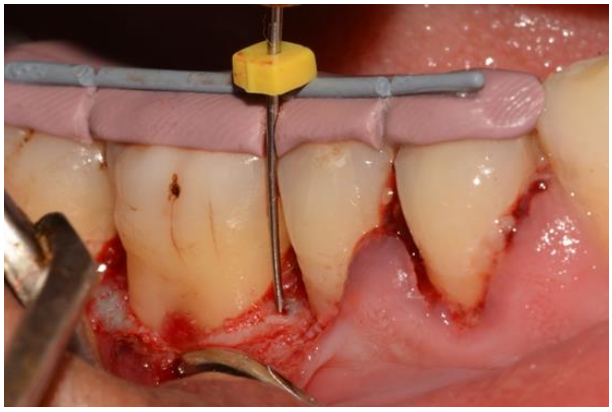
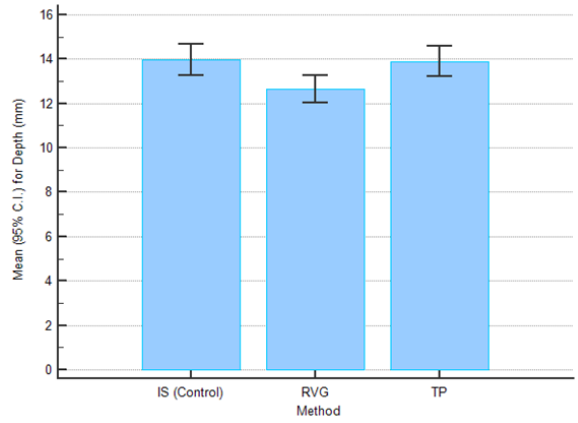


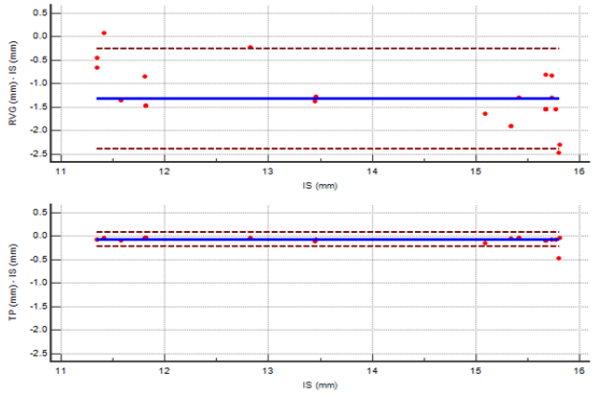
Fig 3: Intrasurgical measurement.

Statistical analysis: The overall variance between the three methods of assessment (radiovisiography, transperiodontal probing and intrasurgical method) was analyzed using one-way analysis of variance (ANOVA). The mean values of bone height (bone loss/probing depth) was compared between the three methods for pairwise differences using paired t-test. Comparison of multiple methods is an extension of the Bland Altman plot for more than two methods. For each method, the differences with a reference method were plotted against the values of this reference method [7,8].

Fig 4: Measurement by digital caliper.



Graph 1: Graph showing comparision between TP and RVG with IS.



Graph 2: Bland & Altman plot: The difference between mean value of defect depth using transperiodontal probing and intrasurgical method is close to 0.

RESULTS

Plot differences: For the 30 samples mean value of defect depth is 12.65±1.64 mm for RVG which is lesser than both Intrasurgical (13.97±1.84) mm and transperiodontal probing (13.90±1.82) mm. According to Bland & Altman plot, differences between mean value of defect depth using RVG and IS has negative value. Hence there is an underestimation of bone defect depth with RVG method. The difference between mean value of defect depth using transperiodontal probing and intrasurgical method is close to 0.(graph I, graph II)

DISCUSSION

The aim of the present study was to compare the bone levels measured by transperiodontal probing (TP) and radiographically by Radiovisiography (RVG) with the bone level measured intrasurgically (IS). Another purpose was to determine whether TP is a valid for establishing the most coronal level of supporting bone at selected points along the dental arch. If the method correlated well with surgical measurements, it would serve a useful role in evaluating the effectiveness of certain therapeutic procedures used in the treatment of periodontal disease without the need for surgical reentry of the operated site.

Theilade in 1960 studied the reliability of radiographs in the measurement of bone loss in periodontal disease. He x-rayed 39 human mandibles and had these films scored by four periodontists, each using the indices of Miller and Seidler, Sheppard and Russell. The findings revealed a severe underestimation of bone loss due to the lack of information on buccal and lingual bone levels in an ordinary radiograph. He also reported that all types of lower teeth examined in this study (except third molars) had the greatest bone loss on the buccal side. Prichard while stressing the value of radiographs in the diagnosis of the periodontal lesion, also called attention to the limitations which are imposed by the nature of this technique[9]

The position of the mucogingival junction in relation to the alveolar bone margin was found by Strahan to be subject to many possible variations and, therefore, not a useful landmark for estimating the level of the alveolar crest[10].

The only definite measurement of alveolar bone level to date which has been thoroughly accepted is direct vision via a surgical approach. Many investigators have used this technique as a basis to test other methods of alveolar bone assessment as well as to directly evaluate results of therapy. Although reliable, this procedure is rather drastic and difficult to justify when it is used on human subjects for the sole purpose of evaluating postoperative results. Easley and later Tibbetts and Ochenbein and Ross described a "sounding" technique for plotting the morphological outline of the alveolar bone in mesiodistal or buccolingual sections[11,12,13]. This procedure performed with local anesthesia utilized the periodontal probe pushed through the gingival tissues as a sounding device to determine the shape of infrabony defects.

A custom made stent was used for consistent measurement of the site in question. Hassell et al (1972) reported that the accuracy of probing in evaluation of attachment level might suffer if the site and direction of the probing were not consistent[14]. The same problem may occur in the evaluation of regenerative therapy. Therefore, a consistent reference and orientation for probing are needed. An onlay-type stent which can guide the probe to an exact location with a proper orientation may be used instead. Clark (1987) and Badersten et al (1984) reported that the onlay-type stent could enhance the reliability of attachment level assessment[15].

Probing depth is defined as the distance from gingival margin to base of the periodontal pocket. There are various histological studies which studied the depth of the probe insertion as compared to intra surgical measurement. They suggested that bone level is not reached by the regular probing method and hence trans-gingival probing was opted for the same.

Easley termed the bone sounding technique in which a probe was inserted until it contacts the bone. In this method, a probe is penetrated horizontally and vertically through the anesthetized gingiva down to the bone in order to assess the bone morphology[11]. Greenberg et al. called the above technique as transgingival probing and found that vertically probing the bone level and the surgically measurements were closely correlated[4].

In the present study, on comparison between TP and RVG there was statistically significant difference in the values with a standard deviation of ±0.516, which is in accordance with the study done by Renvert et al (1981) who reported that radiographic bone height showed lower degrees of correlation with bone probing depth[16].

In the present study the mean difference between TP and IS was 0.069±0.079mm. The difference was statistically significant although clinically it was not relevant. ($p<0.0001$). A digital caliper and plugger was used for measurement which has an accuracy of 0.01mm. This might be the reason for statistically significant difference between TP and IS values. These results are not in agreement with those of Renvert et al in (1981) who reported that a high correlation between bone probing depth and surgical entry levels with correlation coefficient of 0.75237. Ursell et al in 1989 stated that transgingival probing was an accurate method of measuring alveolar bone levels[17].

On comparison between RVG and IS a statistically significant difference was obtained which is in accordance with Shrout et al (1996) who reported radiographic determination of bone loss lacks accuracy which may be attributed to patterns of bone destruction which vary with the severity of the disease, especially in interproximal areas[18]. Burnett in 1971 reported the tendency of radiographs to underestimate actual bone loss[19]. The results of this study suggest that, RVG underestimates the bone level measurements compared to TP and IS which is in accordance with Hyun-Young Kim et al (2000) who concluded that there was hardly any difference between the transgingival probing and actual surgical bone level[20]. With the use of radiographs there are chances of radiation exposure also, hence it might not be the most preferred option for assessing bone levels.

IS provides actual bone level assessment but it requires surgical re-entry which might hamper wound healing and may also be inconvenient for the patients. Hence transgingival probing highly co-relates with bone levels measured surgically, is the most reliable method for assessing bone levels before and after surgical procedures.

The results of this study showed that only TP could be compared with the gold standard-IS. This was in agreement with the study which was done by Yun JH et al, in which he evaluated the bone sounding and radiographic measurements for 24 infrabony defects, and compared them with intrasurgical measurement, and concluded that, bone sounding is a reliable method for the assessment of the actual bone level, following any type of periodontal regenerative therapy[21]. Similar results were obtained from 38 first molars in a study done by Hyung-Young et al., where, they concluded that the bone sounding measurement was a reliable method for the assessment of the actual bone level, after periodontal regenerative therapy[20]. A similar study by Ursell et al. also concluded that measurement values of TP was nearest to intrasurgical measurement values[17]. Akesson et al., did a study which considered 237 sites to compare marginal bone levels with techniques like panoramic, bitewing, periapical and bone probing. They concluded that the most accurate values were those obtained by probing bone before surgery, deviating at most 5% from the true value, followed by periapical radiography, which was more accurate than panoramic and bitewing radiography[22].

Various studies have used other methods such as, the use of grid, graph sheets, profile projector and computer assisted evaluation for standardization of method to detect bone levels. Similarly, all efforts were made to standardize the technique and interpretation of RVG. The equipment used was Kodak RVG software. The results obtained in this study showed that in general there was no total agreement between the reading obtained by RVG and the actual bone height.

CONCLUSION

The following conclusions were drawn from the present study:

1. Though intrasurgical measurement is the gold standard method, it requires a surgical reentry which is not feasible at all times. The measurements obtained by transperiodontal probing were proven to be the closest to the intrasurgical method. Although standardization had been used to achieve accurate results, RVG readings underestimated the values when compared with intrasurgical measurements.

2. Although the difference of RVG readings was statistically significant when compared to intrasurgical readings, clinically the mean difference was 1.3180mm with a standard deviation of 0.5446 which proves that the data are clustered closely around the mean. Hence the use of RVG is a reliable method when proper standardization is used.

3. The values obtained by transperiodontal probing were nearest to those obtained by intrasurgical measurement, having mean difference of 0.069mm with standard deviation of 0.07 which proves that values obtained by transperiodontal probing method was closest in accuracy to intrasurgical measurement.

4. Since standard deviation in transperiodontal probing is also very less (S.D.=0.07); this method is more reliable than RVG (S.D.=0.5446)

Limitations

The limitations of the present study are as follows:

1. There was no differentiation between the types of bone loss i.e. whether bone loss was vertical or horizontal bone.

2. Only proximal bone loss was included in the study.

3. In angular bone loss, the form of onlay stent restricts the advancement of plugger to the most apical point on the bone.

4. The use of plugger in the last molars restricts its advancement to the most apical point on the bone.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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