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Research Article

Comparison between Conventional Radiography (IOPA) and Digital Radiography Using Bitewing Technique in Detecting the Depth of Alveolar Bone Loss

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Abstract: The objective of present study is to assess the depth of alveolar bone loss by using Conventional radiography (IOPA) and Digital radiography (RVG) technique in periodontitis as it affects the connective tissue attachment and supporting bone around the teeth. The study was carried out on 40 males and 10 females aged between 20 – 65 years who have generalized mild to severe chronic periodontitis. A series of conventional bitewing radiographs and digital bitewing radiographs (15,16,17,25,26,27,35,36,37,45,46,47) were taken for each patient. The Statistical software namely SPSS version 16.0 was used for data analysis. Paired t-test was performed on all the variables to evaluate between both the groups at $p \leq 0.05$. The overall results showed the mean statistical difference between both the conventional and digital bitewing radiographs as 0.4595. It was observed that overall digital bitewing radiographs averaged about 0.4mm greater bone loss than conventional bitewing radiographs. It was concluded that digital radiographs showed better results when compared to conventional radiographs in terms of alveolar bone loss as RVG has superior image recording capabilities.
Keywords: Alveolar bone, Conventional radiography (IOPA), Digital radiography (RVG).

INTRODUCTION

Diagnosis is the process of assessing a patient's health as well as ensuing opinions formulated by clinicians. Oral diagnosis is the art of using scientific knowledge to determine the nature of oral diseases and distinguishing it from other diseases[1].

Radiography is a well established procedure in daily dental practice and is still the most basic and an important diagnostic tool available. Radiographs play an integral role in the assessment of periodontal diseases. Conventional bitewing and intra oral periapical radiographs are commonly used to detect alveolar bone loss associated with periodontal disease. They provide unique information about the status of the periodontium and a permanent record of the bone throughout the course of the disease. However, the quality of an X-ray sensitive film can be affected by multiple variables such as improper exposure, under-or overdeveloping and poor fixing[2].

Over the past few years, systems that can generate radiographic digital images without the need for radiography film have become available for use in clinical practice and are gaining popularity among practitioners. Such digital radiography can also reduce the radiation exposure. One of the most useful advantages of digital radiography is the knack it provides to the clinicians to send images to practitioners in a matter of minutes, for which it has become widely accepted as an alternative to film-based radiography[1].

A few studies (most of which were performed in vitro) that examined the use of digital radiography in evaluating crestal alveolar bone loss associated with periodontal disease listed out few of its main advantages over conventional radiography to be speed, convenience, lack of dark room procedures, image improvement tools and dose reduction. Thus the implementation of digital radiography in a dental practice seems to provide a solution for the future imaging requirements[2].

Nevertheless, according to some authors intra oral direct digital radiographs are not an equivalent substitute for conventional radiographs in evaluating alveolar bone levels. [3] Few of its disadvantages include cost of the device, cost of converting previous records to digital, learning to use the concept, thickness of sensor and lack of universal use of digital radiography[4].

In recent years, a digital imaging system – Radiovisiography (RVG) has offered an alternative and instant method for measurement of intraoral radiography[5]. It has been reported that RVG system provided approximately an 80% reduction in radiation dosage in comparison with conventional X-ray films[6].

The present study was aimed at the comparative evaluation of conventional and digital radiography (RVG) to measure alveolar bone loss in an attempt to help the clinician and practitioner to select the reliable radiographic method for imaging and detection of alveolar bone loss.

METHODS

This study was carried out among fifty patients who were randomly selected from the OPD of Department of Oral Medicine and Radiology in P.M.N.M Dental College and Hospital, Bagalkot. The study included 40 males and 10 females aged between 20 – 65 years.

Inclusion criteria

Patient having generalized mild to severe chronic periodontitis as assessed by measuring attachment loss and categorized as mild: 1-2mm, moderate: 3-4 mm, severe: ≥ 5 mm.

Exclusion criteria

Patients with drifted teeth, supra erupted teeth and those who were contraindicated for any radiographic procedure were excluded from the study.

A series of conventional bitewing radiographs (15,16,17,25,26,27,35,36,37,45,46,47) were taken for each of fifty patients having chronic periodontitis using Satelec dental X-ray unit operated at 70 Kvp and 8mA with a radiation exposure of 0.8 seconds. The film used was Kodak E – speed, number 2 of size 41x 31mm (Ekta speed, Eastman Kodak, Rochester, USA) and processing of the film was done manually using time temperature method. Radiographs were mounted on x-ray viewer and alveolar bone loss was measured by keeping divider on the CEJ to the most apical level of marginal bone. Later transparent ruler was used to evaluate the distances between the two points of divider (Figure 1). Similarly a series of digital bitewing radiographs (15,16,17,25,26,27,35,36,37,45,46,47) were taken for each of fifty patients by using RVG of Kodak 5000 system and Satelec dental X-ray unit operated at 70 Kvp and 8mA with a radiation exposure of 0.2 seconds. To ensure maximum hygiene, we covered the sensor with plastic sleeves and for each patient a new plastic cover was used. The system we used in our study contained a charged coupled device or CCD sensor. The measurement in RVG was done using Kodak 5000 digital software (Figure 2). Radiographically for the measurement of bone levels from both methods we considered normal bone level less than 2mm from the CEJ, and above that we measured as bone loss. Total 600 sites were measured and 3 readings were taken from each site and mean of 3 readings is taken as a final readings.

Fig-1: Measurement of alveolar bone loss using conventional radiography (IOPA)

Fig-2: Measurement of alveolar bone loss using Radiovisiography (RVG)

Statistical analysis

The Statistical software namely SPSS version 16.0 was used for data analysis. Paired t-test was performed on all the variables to evaluate between both the groups at $p \leq 0.05$. Relative agreement between the groups was done with Pearson's Correlation Coefficient.

RESULTS

Fifty subjects were included in the study and total number of sites measured was 600. The overall results show that the mean difference between both the conventional and digital bitewing radiographs was -0.4595 and the standard deviation difference were 0.2409 which is statistically significant (Table-1). It was observed that digital bitewing radiographs evaluated about 0.4mm greater bone loss on an average than conventional bitewing radiographs.

By using paired t- test, results showed differences between right and left side sextants. In right maxilla, conventional images showed mean bone loss of 4.1mm, while digital images indicated a mean bone loss of 4.2mm, which was statistically significant. In the left maxilla conventional images showed a mean bone loss of 4.5mm while digital images showed an average loss of 4.6mm, which was statistically significant (Table-2). Where as in right mandible conventional images showed averaged bone loss of 3.3mm, while digital images showed 4.0mm of averaged bone loss with a significant p- value. In left mandible conventional images showed averaged bone loss of 3.7mm, while digital images showed 4.0mm of averaged bone loss with a significant p- value (Table-3).

RVG showed more bone loss in mandible than conventional radiographs but in maxilla both methods are showing almost similar measurement with a mean difference of 0.1mm only. Using Karl Pearson's correlation coefficient (r = 0.9359), there is a relative agreement of bone level measuring between conventional and digital bitewing radiographs (Table-4). Significant correlation was found between the RVG and conventional methods in both right and left sextant of both jaws ranging from r = .82 to r = .91 with a significant p- value (Table 5).

Table-1:Comparison of Conventional (IOPA) and RVG methods (bitewing technique) in total samples by using paired t-test.

Method	Mean	SD	Mean Diff	SD Diff	p-value
IOPA	3.9400	0.6666	-0.4595	0.2409	0.000
RVG	4.3995	0.6777			

Table-2: Comparison of Conventional (IOPA) and RVG methods (bitewing technique) in Maxilla by using paired t-test.

Method	Mean	SD	Mean Diff	SD Diff	p-value
IOPA (Right)	4.1067	0.7610	-0.1560	0.4769	0.001
RVG (Right)	4.2627	0.8200			
IOPA (Left)	4.5200	0.9102	-0.1733	0.3784	0.000
RVG (Left)	4.6933	0.8660			

Table-3: Comparison of Conventional (IOPA) and RVG methods (bitewing technique) in Mandible by using paired t-test.

Method	Mean	SD	Mean Diff	SD Diff	p-value
IOPA (Right)	3.3467	0.7942	-0.7120	0.4355	0.000
RVG (Right)	4.0587	0.8505			
IOPA (Left)	3.7867	0.9803	-0.7967	0.4869	0.000
RVG (Left)	4.5833	0.9479			

Table-4: Relative agreement of bone level between measurements from Conventional (IOPA) and RVG method using Karl Pearson's correlation coefficient technique (Total sample)

	Conventional radiograph method (IOPA)	
Methods	r-value	p-value
Radiovisiography (RVG)	0.9359	0.0000

Table-5: Relative agreement of bone level between measurements from Conventional (IOPA) and RVG method using Karl Pearson's correlation coefficient technique

	Conventional radiograph method (IOPA)	
Methods	r-value	p-value
Radiovisiography (RVG) (Right maxilla)	0.8206	0.0000
Radiovisiography (RVG) (Left maxilla)	0.9104	0.0000
Radiovisiography (RVG) (Right mandible)	0.8620	0.0000
Radiovisiography (RVG) (Left mandible)	0.8730	0.0000

DISCUSSION

Radiographs provide unique information about the status of the periodontium and a permanent record of the condition of the bone throughout the course of the disease. Radiographs aid the clinician in identifying the extent of destruction of alveolar bone, local contributing factors, and features of the periodontium that influence the prognosis[2].

The diagnosis of periodontal disease is primarily based on clinical examination. The clinical findings of periodontal osseous destruction can be confirmed by radiographic examination, but the radiographs on its own cannot help in diagnosing the disease[7].

Radiographic digital imaging systems like electronic probing system, substraction radiography, CADIA (Computer Assisted Densitometric Image Analyses System), Dark field microscopy, DNA probes, Immunodiagnostic methods have been developed in recent times, which act as an adjunct in the precise diagnosis of periodontal disease.[8]

Khocht et al stated that digital radiography offers many advantages over conventional methods[1]. It eliminates the need for film and film developing, and it allows for lower radiation exposure. The generated image is available immediately for evaluation on a computer screen and can be manipulated digitally to enhance viewing. In addition, digital tools are available to record electronic measurements and to cut, paste and colorize the image. The image can be easily filed on and retrieved from the hard disk or removable storage medium, or the images can be transferred electronically to third party carriers[9].

Apart from these, one more advantage is the immediate observation of radiographic images. Only few digital radiography devices provide immediate viewing like charged coupled devices or CCDs[10]. However phosphorous plate technology requires placement of irradiated sensor in a processing device to scan it and put the information into a computer so that image can be viewed. In conventional radiographic techniques, the delay in reading the image usually forces the clinician to change his gloves and linger elsewhere as the radiographs undergo development[11].

RVG is also useful in educating and motivating the patient[12]. During implant placement, using conventional radiography is a major inconvenience, as the entire aseptic procedure is disrupted and time is wasted while the clinician awaits the development of the films several times during implant placement procedure[13]. It also allows the clinician to change contrast, enlarge images, place color enhancements or superimpose various textures on images[14].

However, as both advantages and disadvantages of any new invented device go hand in hand, the drawbacks include cost of the devices as well as converting previous records to digital, which are very high, thickness and rigidity of sensor that makes the patient uncomfortable, loss or breakage of sensor, which can prove very costly.

The clinical implications of radiography in the diagnosis of periodontal disease are twofold; to visualize the initial status of the bone tissue and to

illustrate changes in bone tissue over time. When there are so many radiographic techniques, the clinician is in a dilemma as to which technique has to be used. This study was an attempt to help the clinician select the reliable radiographic method in imaging and detection of periodontal osseous destruction[15].

The results of the present study showed that overall the digital bitewing images averaged 0.4mm greater bone loss than did the conventional images with a significant p-value. Similarly, in a study conducted[1], digital radiography measured 0.3mm greater bone loss than conventional bitewings with significant p- value, which is relatively consistent with our results.

Given the overall difference between conventional and digital bitewing radiographs, we wanted to know if this difference was consistent across all sextants of the mouth. Therefore, we computed paired t- test for each of the four sextants available and our results showed measurement differences in RVG and conventional radiographs in all four sextants of the jaw.

RVG showed more bone loss in both maxilla and mandible than conventional radiographs, but in maxilla both methods are showing almost similar measurement with a mean difference of 0.1mm only. However, in the study of Ahmed Kotch et al digital radiographs observed bone loss only in the posterior mandibular region and measurements of bone loss in the posterior maxillary region were similar between the two radiographic methods[1].

Engebretson et al stated that there is no significant difference in conventional and digital radiographs as such but digital radiographs are more accurate in measurements than film- based radiographs[16]. In our study also, RVG showed more accuracy than conventional radiographs while measuring alveolar bone loss.

In the present study, we observed that in the normal clinical use, significant difference exists between alveolar bone loss measurements on digital and conventional radiographs in several regions in the mouth. This difference noted between the two imaging systems may be attributed to variations in measurements, which were done manually in case of conventional radiographs and digitally in case of digital radiographs, because RVG was showing 0.4mm greater bone loss than conventional radiographs while comparing the total samples. These variations may be due to flexibility of the conventional radiograph film and sensor used in digital radiography.

CONCLUSION

It can be hereby concluded that the digital radiographs have an upper hand when compared to conventional radiographs in terms of alveolar bone loss. Although RVG has superior image recording capabilities compared to conventional radiographs, its cost factor is an important point of consideration, which can limit its use.

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