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COMPARISON BETWEEN CONVENTIONAL RADIOGRAPHY AND DIGITAL RADIOGRAPHY (RVG) USING BITEWING TECHNIQUE IN DETECTING THE DEPTH OF ALVEOLAR BONE LOSS IN CHRONIC PERIODONTITIS.

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Abstract
Aim- To compare the diagnostic accuracy of conventional intraoral periapical radiograph and digital radiovisiograph (RVG) in detecting interdental alveolar bone loss in chronic periodontitis cases.
Materials and method- 30 subjects have been enrolled who voluntarily signed an informed consent after obtaining institutional ethical committee clearance. Patients were informed about the objectives of the study and explained about the benefits and risks involved.
240 inter-dental sites were considered for the study. The sites included distal, mesial surfaces of the mandibular first molar, maxillary first molar, mandibular first and second premolar maxillary first and second premolar. Patients having generalized mild to severe chronic periodontitis as assessed by measuring attachment loss and categorized as mild: 1-2 mm, moderate: 3-4 mm, severe: ≥ 5 mm.
Result –Comparison of conventional and digital radiographic techniques in left maxilla, left and right mandible, and between maxilla and mandible in the total sample and in female ,male yielded no significant correlation ,while comparison of the two techniques in in detecting interdental alveolar bone loss in chronic periodontitis cases yields significant difference.
Conclusion-Direct digital radiography provides an edge over conventional radiography in assessing the periodontal bone destruction in chronic periodontitis.
Keywords-Alveolar bone level, conventional intraoral bitewing radiographs, direct digital radiography, periodontal disease.

Introduction-
Oral diagnosis is the art of using scientific knowledge to determine the nature of oral diseases and distinguishing it from other diseases, an effective oral diagnosis can be done through oral inspection and radiographic inspection. Radiographic examination is a complementing mean of great importance to obtain the diagnosis of periodontitis ,even though it does not reveal the real state of cellular activity, but shows the consequences upon dentoalveolar structures .That along with clinical examination, provides a detailed assessment of the bone defect, reaching a correct diagnosis of horizontal and angular alveolar boneless.
Besides diagnosis, imaging examination helps in planning treatment, periodic check-ups and, finally in the prognosis. Conventional intraoral bitewing radiographs are commonly used to detect incipient 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 can be affected by multiple variables such as improper exposure, under-or overdeveloping and poor fixing, quality of x-ray film, handling of the film.

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. Digital radiography can also reduce the dark room procedures, handling errors of x-ray film. One of the most useful advantages ofdigitalradiography is that it provides a wayto the clinicians to send images to practitioners and patient in a matter of minutes, for which it has become widely accepted as an alternative to film-based radiography.Bone loss at the crest of the alveolar bone and interdental Osseous defects are the frequent squeal of periodontal disease.

Diagnosing their presence and establishing their morphology before surgical access requires a careful clinical examination combined with diagnostic quality radiographs.

We can measure the incipient alveolar bone loss by both the conventional bitewing radiographic technique and direct digital radiographic technique (RVG). To assess the incipient alveolar bone loss so to reduce the time and avoid darkroom procedures, manual errors in measurement of alveolar bone loss we will be using direct digital radiography (RVG).

The position and shape of the alveolar margins are indices of health and disease to both the general dentist.. In examining these, the use of radiographs plays an important diagnostic role. Bjorn, Hailing and Thyberg (1969**)**, who mounted intra-oral radiographs in frames and projected the images onto a back-projection table on which a scale had been drawn. They established bone heights relative to tooth lengths by means of this method.[1]

The development of direct digital radiographic methods has made it possible to reduce the radiation dose and to enhance the image quality after image acquisition. The diagnostic accuracy of direct digital radiography has been shown to be comparable to that of conventional film radiography for the detection of experimental bone tissue lesions.[2] The shortcomings of film-based radiography, which have been dealt with in previous studies, include processing errors, increased radiation dose in comparison with direct digital images, poor imaging geometry, and lack of post-imaging enhancement facilities.[3]

Along with marginal inflammation, periodontal pocket formation, and attachment loss, alveolar bone loss is a primary feature of periodontitis. The height of the alveolar bone may be evaluated by intrasurgical inspection or, less invasively, by radiographic examination; however, radiographic assessment tends to underestimate the amount of bone loss.[5]

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.

Digital measurement with RVG may improve diagnostic interpretation of radiographs in terms of accuracy .[7] Digital radiology was invented because of the need for improvement in diagnostic imaging. The digital system presents features that provide greater dynamism to images, facilitates interpretation and diagnosis of proximal changes. In addition, the accuracy of diagnosis can be enhanced by programs that filter the images. These programs can adjust the brightness and contrast, determine the grey level, inverte the shades of grey, and apply pseudocolors.[9] The correct diagnosis of periapical lesions by radiographs should be carefully done and the diagnosis will define the treatment choice and prognosis. In addition, the radiographic examination is fundamental to assess the repair or the persistence of posttreatment periapical lesions.[10]

Radiographs have been used in medicine since 1895 when Wilhelm Conrad Roentgen discovered the roentgen rays. One year later, the radiographic technique was used by Morton in the diagnosis of periodontal disease. With the Introduction of the concept of focal infection, radiographs became commonly accepted in dentistry. Progression of periodontal disease leads to periodontal bone loss with resorption of the alveolar crest and tooth mobility and it is considered one of the most prevalent oral diseases in adult population. The clinical and radiographic examinations play an important role in the diagnosis and management of the disease .[11]In periodontics, radiographs have mainly been used to assess the loss and destruction of alveolar hone and to confirm a clinical diagnosis of trauma from occlusion. Intraoral radiographs are generally preferred due to their sharpness and ability to demonstrate structural details.[12]

Bone loss has been expressed as a percent of total root length or of total tooth length, and more recently in terms of absolute measurements in millimeters. Low sensitivity for subtle changes is considered to be the major limitation of these conventional interpretations of radiographic images of periodontal bone support.[13]Periodontitis is an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms, resulting in destruction of the gingival, periodontal ligament and alveolar bone. Progressive loss of alveolar bone is an important feature of periodontal disease. Accurate detection of periodontal disease with the use of radiographs helps in diagnosis, treatment plan and prognosis. Bone loss at the crest of the alveolar bone and interdental osseous defects are the frequent sequelae of periodontal disease. Diagnosing their presence and establishing their morphology

before surgical access requires a careful clinical examination combined with diagnostic quality radiographs .[21]

AIM AND OBJECTIVE –

To compare the diagnostic accuracy of conventional intraoral periapical radiograph and digital radiovisiograph (RVG) in detecting interdental alveolar bone loss in chronic periodontitis cases. The main objective of this study is to estimate the diagnostic accuracy of conventional intraoral periapical radiographs and digital radiovisiography in detecting interdental alveolar bone loss in chronic periodontitis using digital radiovisiography measurements as the gold standard and to suggest the most accurate technique to be used in the clinical departments.

MATERIALS AND METHODS –

The study was observational comparative study in which 30 subjects have been enrolled who voluntarily signed an informed consent after obtaining institutional ethical committee clearance. Patients were informed about the objectives of the study and explained about the benefits and risks involved. 240 inter-dental sites were considered for the study. The sites included distal, mesial surfaces of the mandibular first molar, maxillary first molar, mandibular first and second premolar maxillary first and second premolar. Patients having generalized mild to severe chronic periodontitis as assessed by measuring attachment loss and categorized as mild: 1-2 mm, moderate: 3-4 mm, severe: ≥ 5 mm.The protocol of the study was approved by the institutional ethical committee, study duration was18 months. The size of the study sample consisted of 30 patients and 240 sites were examined including premolar and molar region in the patient who were randomly selected from the OPD of Department of Oral Medicine and Radiology.

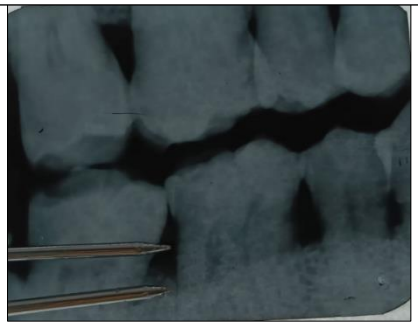
Study population Individuals ranging from 35-60 yrs with mild to moderate chronic periodontitis involving premolar,molar region were selected.

Sample size determination

$$n = \frac{2Z1^2S^2}{d^2}$$

Formula of calculating sample size is:- Sample size for two independent sample(outcome variable measured on ratio scale and testing alternate hypothesis:m1#m2(means of both groups unequal)

Patient positioned for conventional bitewing radiograph



Conventional method of measuring alveolar crestal boneloss.

Patient positioned for digital bitewing radiovisiograph

Digital method of measuring alveolar crestal boneloss

RESULT –

This study was conducted to compare the depth of alveolar bone loss by conventional radiography and digital radiography using bitewing technique. In our study gender distribution of study population, 16 (53.3%) were found to be males and 14 (46.7%) were females, mean age of study population was found to be 43.73 years , standard deviation was 7.29 years, Standard error was 1.33, minimum age in study group was 34 years and maximum age was 56 years. Mean measurements was higher in Group B (Digital) as compared to Group A (Conventional at all four sites i.e. Site 1-4 but the difference was not found to be of statistical significance at Site 1(mesial aspect of mandibular first premolar)Mean measurement in Group A (Conventional Radiography) was 5.36mm (1.51) and Group B (Digital Radiography) was 5.62mm (1.47)at Site 2(Distal aspect of mandibular first premolar)mean measurement in Group A (Conventional Radiography) was 5.3mm (1.37) and Group B (Digital Radiography) was 5.7 mm (1.33)at Site 3(mesial aspect of mandibular first molar)mean measurement

in Group A (Conventional Radiography) was 5.25 mm (1.37) and Group B (Digital Radiography) was 5.6 mm (1.36)at Site 4(Distal aspect of mandibular first molar)mean measurement in Group A (Conventional Radiography) was 5.32 mm (1.36) and Group B (Digital Radiography) was 5.76 mm (1.3)Comparison between Group A (Conventional Radiography) and Group B (Digital Radiography) at Site 5(mesial aspect of maxillary first premolar)mean measurement in Group A (Conventional Radiography) was 5.32 mm (1.43) and Group B (Digital Radiography) was 5.76 (1.38)at Site 6(Distal aspect of maxillary first premolar)mean measurement in Group A (Conventional Radiography) was 5.31 mm (1.4) and Group B (Digital Radiography) was 5.56 mm (1.4)at Site 7(mesial aspect of maxillary first molar)mean measurement in Group A (Conventional Radiography) was 5.29 mm (1.36) and Group B (Digital Radiography) was 5.6 mm (1.34) at Site 8(Distal aspect of maxillary first molar) mean measurement in Group A (Conventional Radiography) was 5.24 mm (1.31) and Group B (Digital Radiography) was 5.83mm (1.22) ,when compared all values in digital and conventional measurements for all sites mean measurements was higher in Group B (Digital) as compared to Group A (Conventional)at all eight sites i.e., Site 1-8 but the difference was not found to be of statistical significance.

DISCUSSION

Periodontitis is an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms, resulting in destruction of the periodontal ligament and alveolar bone. Progressive loss of alveolar bone is the salient feature of periodontal disease. Periodontitis involves progressive loss of alveolar bone around the teeth, if left untreated leads to subsequent loss of teeth. It is characterized by periods of activity in which the periodontal supporting structures are destroyed by the action of chemical mediators of inflammation. Accurate detection of periodontal disease with the use of radiographs helps in diagnosis, treatment and prognosis. The goal of dental radiology is to make an accurate diagnosis using the most effective imaging modality with the lowest radiation possible[25].

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. The diagnosis of periodontal disease is primarily based on clinical examination. The clinical findings of periodontal osseous destruction can be confirmed by radiographic examination[22].

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.[22]

Monitoring bone changes with relatively simple radiographic procedures has proven to be an elusive objective in clinical periodontics. Bone loss has been expressed as a percent of total root length or of total tooth length, and more recently in terms of absolute measurements in millimeters. Low sensitivity for subtle changes is considered to be the major limitation of these conventional interpretations of radiographic images of periodontal bone support.

Along with marginal inflammation, periodontal pocket formation, and attachment loss, alveolar bone loss is a primary feature of periodontitis. The height of the alveolar bone may be evaluated by intrasurgical inspection or, less invasively, by radiographic examination; however, radiographic assessment tends to underestimate the amount of bone loss. Changes of mineralized tissue like alveolar bone may be detected radiographically from consecutive radiographs.[4]

The advent of direct digital imaging has introduced a versatile imaging tool that can be used for a variety of tasks, including detection of alveolar crestal bone defects. The reported prevalence of alveolar bone loss, which is a common dental disease state, may vary depending on the epidemiologic conditions of the study.[5] In periodontal diseases, the bone destruction pattern is divided into horizontal (even) and oblique (vertical/angular) defects. In the vertical pattern, bone destruction does not proceed in a symmetrical pattern. The severity of bone destruction varies in different parts around the tooth, which explains why the alveolar crest does not correspond to cemento-enamel junction and

is not parallel to it. This bone destruction pattern gives rise to bony defects in which the base of the defect is located more apical to the alveolar crest.[5]

Although some studies have found the statistically significant difference between the measurements taken by conventional and digital radiograph, we in our study did not find any significant difference between the measurements taken by two radiographic methods. This could be due to all the efforts which were made to standardize both radiographic techniques to avoid any geometric errors and all precautions taken such as proper positioning of patient while taking radiographs; proper angulation of X-ray cone could have led to more accurate measurements. Although all the results were found to be nonsignificant, observations showed that conventional method is difficult to give accuracy in case of alveolar crestal boneloss. However, direct digital radiographs (RVG) are preferred, as the imaging software of digital radiographs provides the following advantages as less radiation exposure, immediate digital image display on computer after exposure, it enlarge the radiographs for easy viewing, ability to adjust the contrast for better visualization, ease of taking measurements, the convenience of having immediate access to radiographic records stored in computer and easy to retrieve ,view ,and transport data and also save the time by eliminating the need of manual processing of film, which is required for the processing of conventional radiographs. The need for light proof dark room is also omitted. However, in cases, where direct digital radiographic method is not available for the evaluation of alveolar bone, conventional radiographic techniques such as conventional bitewing radiographs can be used, as the above results of the study did not show any statistically significant difference in the measurements that were taken by conventional and digital radiographic techniques when compared to the measurements which were taken as the gold standard.

CONCLUSION

The present study compared the efficacy of digital radiographs in measuring the alveolar bone loss. Total 240 sites of 30 patients were evaluated (16 males and 14 females) who were aged between 34 and 56 years of age. Alveolar bone loss was measured from the CEJ to the most apical level of marginal bone on the readable surfaces. Two hundred and forty image sites were examined using conventional and digital bitewing radiographs showing more bone loss using digital radiographs in all the 4 quadrants of the jaws than conventional radiograph. The data obtained were recorded in tabloid form and statistically analysed using paired t-test, Post Hoc test, and Pearson correlation test. After analysing the data following conclusions were drawn: Under normal clinical use, significant difference existed between alveolar bone measurements on digital and conventional radiographs in several regions of the mouth. Thus, it could be said that the digital radiograph had an upper hand compared to conventional radiographs in terms of measurement of alveolar bone loss, radiation exposure, time management. Although RVG is superior in measuring the alveolar bone loss compared to conventional radiographs, its cost must be taken into account, which is quite high than the conventional radiograph.

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Table 1: Gender distribution of study population

	Frequency (n)	Percentage (%)
Male	**16**	**53.3%**
Female	**14**	**46.7%**
Total	**30**	**100%**

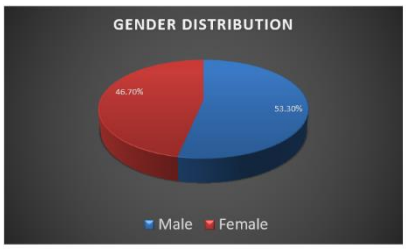

Table 2: Descriptive statistics of age distribution(in years)

Mean	SD	SE	Minimum	Maximum
43.73	7.29	1.33	34	56

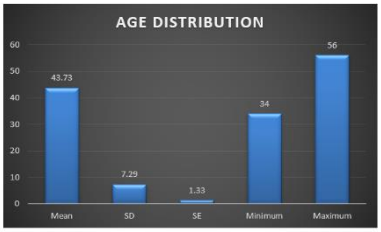

Table 3: Comparison between Group A (Conventional) and Group B (Digital) respectively

	Group A (Conventional) Mean (SD)	Group B (Digital) Mean (SD)	Mean Difference (SE)	Unpaired t test	P value, Significance
Site 1	5.36 (1.51)	5.62 (1.47)	0.25 (0.38)	t = -0.665	p =0.509
Site 2	5.3 (1.37)	5.7 (1.33)	0.39 (0.35)	t = -1.123	p =0.266
Site 3	5.25 (1.37)	5.6 (1.36)	0.35 (0.35)	t = -0.999	p =0.322

Site 4	5.32 (1.36)	5.76 (1.3)	0.44 (0.34)	t = -1.295	p =0.201

p>0.05 – no statistical significant difference

Table 4: Comparison between Group A (Conventional) and Group B (Digital) respectively

	Group A (Conventional) Mean (SD)	Group B (Digital) Mean (SD)	Mean Difference (SE)	Unpaired t test	P value, Significance
Site 5	5.32 (1.43)	5.76 (1.38)	0.44 (0.36)	t = -1.210	p =0.231
Site 6	5.31 (1.4)	5.65 (1.4)	0.34 (0.36)	t = -0.947	p =0.347
Site 7	5.29 (1.36)	5.65 (1.34)	0.35 (0.35)	t = -1.018	p =0.313
Site 8	5.24 (1.31)	5.83 (1.22)	0.59 (0.32)	t = -1.800	p =0.077

p>0.05 – no statistical significant difference

Table 5: Correlation between Group A (Conventional) and Group B (Digital) respectively

	Pearson correlation coefficient 'r' value	P value, Significance
Site 1	r = 0.953 (strong positive correlation)	P<0.001** (highly significant)
Site 2	r = 0.957 (strong positive correlation)	P<0.001** (highly significant)
Site 3	r = 0.973 (strong positive correlation)	P<0.001** (highly significant)
Site 4	r = 0.943 (strong positive correlation)	P<0.001** (highly significant)

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Table 6: Correlation between Group A (Conventional) and Group B (Digital) respectively

	Pearson 'r' correlation coefficient value	P value, Significance
Site 5	r = 0.972 (strong positive correlation)	P<0.001** (highly significant)
Site 6	r = 0.963 (strong positive correlation)	P<0.001** (highly significant)
Site 7	r = 0.970 (strong positive correlation)	P<0.001** (highly significant)
Site 8	r = 0.921 (strong positive correlation)	P<0.001** (highly significant)